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Agriculture.

DODDER.

All lucerne-growers in Queensland know this pernicious weed, but it has not yet been included in a noxious weeds Act, except perhaps in the Local Authorities Act. In South Australia, a proclamation appeared in the *Government Gazette* of 18th September last year declaring "the following weed (Dodder—*Cuscuta*) to be a noxious weed, and to be included in the Thistle and Burr Act of 1862." In the "Journal of Agriculture of South Australia" for December, 1919, Mr. H. W. Andrew, Botanical Assistant, writes on this pest as follows:—

There are 90 or more tropical and temperate species of *Cuscuta*, a number of which have been distributed throughout the world by means of impure agricultural seed. They belong to the convolvulus or bind-weed family, and are practically leafless and rootless, with no chlorophyll. Among the species most injurious to agriculture are *Cuscuta europea*, L.; *C. epilinum*, Weihe, Flax Dodder; *C. trifolii*, Bab., *C. epithymum*, Murr., Clover Dodder; and *C. arvensis*, Field Dodder. Specimens of the two last-mentioned species infesting lucerne crops have been submitted to the department during the past four or five years.

Most dodders are annuals, and have practically the same development. Each flower normally produces four seeds, and these contain a thread-like spirally coiled embryo. On germinating on the surface of the ground, this grows in a peculiar manner, assuming somewhat the shape of a corkscrew. Unless the seedling soon finds a suitable host plant, it falls to the ground, being unable to obtain food from the soil and air like green plants do. Here it may lie dormant "waiting for something to turn up," but, if it fail to come into contact with a suitable host, will eventually die. On the other hand, should the dodder seedling reach such a host (which it has every chance of doing when dodder-infested seed is sown) it twines itself around the stem of the latter, and its tissues unite with those of its host by means of suckers or *haustoria*. The parasite now loses its connection with the ground, and rapidly extends its thread-like branches (often reddish or yellow) to

adjoining host plants. Depending as they do entirely on the host plant for all food, these absolute parasites are very destructive, and may leave the infested area as though a fire had swept over them.

CONTROL.—PREVENTION.

Efficient control of seed supplies is considered the world over to be the successful means of restricting the distribution of these parasitical weeds. All species of *Cuscuta* are proclaimed weed pests under the Commonwealth Quarantine Act, and clover, lucerne, and other crop seeds containing seeds of dodder from oversea countries are refused admission into South Australia. There is no inspection of such seeds, however, from the other States, though this anomaly will receive consideration in connection with the State Seed Control Bill which the Government have announced their intention of introducing. Where possible, farmers and others purchasing lucerne and clover seeds should send samples of at least 1 oz. or, better, 2 oz. to the department, to have them tested for impurities and germination, for which no charge is made.

EXTERMINATION.

The method of exterminating dodder when once established in a crop depends a good deal on the kind of crop infested, whether annual or perennial; also whether the dodder has seeded before being attacked, &c. Cutting the affected patch and a margin for safety close down (say, with a spade), and afterwards heaping chaff or straw over it and then burning on the spot is recommended. Spraying affected clover with a 15 per cent. solution of sulphate of iron is frequently practised in the northern hemisphere, and, it is claimed, kills the dodder and only injures the clover temporarily. Such infested spots, after burning, are sometimes surrounded by a trench, the soil from which is thrown over the patch, so as to cover it several inches, so restricting the possibility of dodder seedlings which may sprout subsequently breaking through.

As dodder seed may retain its vitality in the soil for several years, a number of examinations should be made of a young growing crop of lucerne or clover for the presence of this serious pest, so as to be in a position to attack it before the seedling stage. Even if found before the seeding stage is reached, it should be burnt on the spot, as the thread-like branches propagate themselves as cuttings.

The so-called "scrub dodders" or "wait awhile" (*Cassytha,* spp.) of Australia are not true dodders or cuscutas, though, like them, depend on their hosts for all nutriment. They do not attack agricultural herbaceous crops. They belong to the laurel family.

HEREFORD CATTLE.

In an article dealing with the foundation and short history of this breed, the "Pastoral Review" says:—

"Natural aptitude to fatten and early maturity are, perhaps, the predominating characteristics of the breed, and they have always been most carefully maintained and developed. The cattle are extremely hardy, and no breed is less susceptible to the terrible scourge of tuberculosis. Hereford cows are splendid mothers, rearing their calves well and maintaining their own condition at the same time. They have exceptionally long lives as breeders. Dropping their first calf usually at about three years of age, they continue breeding up to fourteen and fifteen years. The Hereford bull is a most prepotent sire. Whether crossed with pedigree or mongrel, he invariably transmits to his progeny his own wonderful qualities and characteristics. In addition, the experience of ranchers has proved that, owing to his activity, where a Hereford is used, fewer stock bulls are required. The use of a Hereford bull ensures a high percentage in the calf crop, an immediate gathering up of the stock in which the characteristics of the sire are unmistakeably evident, and, owing to the hardiness of the breed, a large proportion of calves at branding time. They are essentially a beef breed, but when bred for the purpose they prove excellent milkers, the percentage of butterfat being exceptionally high."

Pastoral.

LIVE AND DEAD WEIGHTS OF CATTLE.

The "Farmers' Weekly" (South Africa) has the following article on the carcass yield of cattle:—

The term "carcass yield" means the ratio of the dressed carcass, when prepared for market, to the live weight of the animal. Naturally this varies materially according to breed, age, and condition at time of slaughter; but it may be said in general terms that cattle will average about 55 per cent., sheep about 50, and pigs 78 per cent.

The dressing percentage is an important factor in determining the price received for the animal on foot. Often the animal that is purchased for the lowest figure yields the most expensive beef. In this case the word "expensive" is not synonymous with "high quality." It means that the percentage of waste is so great that the first cost of the saleable parts is in consequence high.

The following table gives a fair idea as to the dressing loss in an average bullock of 1,200 lb. weight:—

	Weight. Lb.	Per Cent. of Live Weight.
Head	32	2.16
Feet	19	1.58
Pluck	26	2.17
Liver	13	1.08
Tongue	3	0.25
Tail	14	1.12
Intestines	36	3.00
Blood and paunch contents	225	18.75
Paunch	32	2.66
Intestinal fat	28	2.33
Hide	75	6.25

The value of a beef carcass depends upon its condition, form, and percentage of high-priced cuts. The relative percentages of weight and value on the market of the wholesale cuts of beef are illustrated by the following table:—

Cuts.	Average per Cent. Weight.	Average per Cent. Value.
Loin	17	33.66
Ribs	9	15.47
Round	23	19.67
Chuck	13	18.30
Plate	13	9.13
Flank	4	0.89
Front shank	4	1.49
Suet	4	1.19

These figures explain why so much importance is attached to loin and rib development in a fat beast. Obviously, the more meat that can be crowded into the higher valued parts the more profitably will the carcass cut up.

It is stated that a choice or prime carcass can be left hanging in the cool chamber longer than that of an inferior animal. A thin carcass loses more in weight than a well-finished one, owing to the greater evaporation. This loss in weight from warm to cold averages from 1.5 to 2 per cent.

Poultry.

REPORT ON EGG-LAYING COMPETITION, QUEENSLAND AGRICULTURAL COLLEGE, DECEMBER, 1919.

Considering the adverse weather conditions, the laying generally has been satisfactory. The birds look well, and the majority have that hard appearance so much sought after that usually points to a late moult. The maximum temperature for the month was 109 degrees, and several days registered over 100 degrees. There were seven deaths during the month—one case of tuberculosis, one with ruptured liver, and five cases of heat apoplexy, the latter all occurring on the 15th. Broodies have again been troublesome. The birds have been fortunate in being able to get plenty of green feed. The laying of Burns's D bird still continues good. In spite of the heat, she laid 30 eggs for the month, bringing her score to 252 for nine months. R. Holmes's E bird laid 26 eggs, making her total 246. T. Fanning's score of 145 is the highest for a group for the month. The following are the individual records:—

Competitors.	Breed.	Dec.	Total.
LIGHT BREEDS.			
*J. M. Manson	White Leghorns ...	130	1,234
*T. Fanning	Do.	145	1,227
*E. A. Smith	Do.	139	1,155
*W. Hindes	Do.	107	1,145
*Dr. E. C. Jennings	Do.	132	1,109
*Dixie Egg Plant	Do.	111	1,100
*G. W. Hindes	Do.	121	1,070
*Haden Poultry Farm	Do.	107	1,055
Range Poultry Farm	Do.	117	1,055
*Quinn's Post Poultry Farm	Do.	116	1,053
*B. Caswell	Do.	121	1,046
*W. Becker	Do.	124	1,033
*L. G. Innes	Do.	119	1,027
J. H. Jones (Toowoomba)	Do.	118	1,026
*C. P. Buchanan	Do.	114	1,015
*Harold Fraser	Do.	118	1,004
S. McPherson	Do.	107	995
*J. J. Davies	Do.	118	985
*Mrs. L. F. Anderson	Do.	110	969
W. A. Wilson	Do.	117	968
*Mrs. A. G. Kurth	Do.	128	963
*W. Lyell	Do.	124	957
G. Williams	Do.	102	956
G. J. Byrnes	Do.	95	939
*Thos. Taylor	Do.	111	935
S. W. Rooney	Do.	102	927
Geo. Trapp	Do.	112	908
H. A. Jones (Orallo)	Do.	104	904
*Mrs. R. Hunter	Do.	100	902
B Chester	Do.	103	872
Mrs. M. Charteris	Do.	121	871
*O. W. J. Whitman	Do.	115	871
C. A. Goos	Do.	104	848
G. H Kettle	Do.	72	848
N. A. Singer	Do.	120	845
J. W. Newton	Do.	118	838
H. O. Jones (Blackstone)	Do.	89	822
Oakleigh Poultry Farm	Do.	95	815
R. C. J. Turner	Do.	93	780
W Morrissey	Do.	89	753
J. H. Dunbar	Anconas	71	723

EGG-LAYING COMPETITION—*continued.*

Competitors.	Breed.	Dec	Total.
HEAVY BREEDS.			
*R. Holmes	Black Orpingtons ...	113	1,253
*E. F. Dennis	Do.	131	1,206
*R. Burns	Do.	132	1,189
*E. M. Larsen	Do.	106	1,157
*W. Smith	Do.	109	1,102
*A. E. Walters	Do.	118	1,090
Geo. Nutt	Do.	79	1,036
*E. Morris	Do.	102	1,034
*Kelvin Poultry Farm	Plymouth Rocks ...	80	1,022
*A. Shanks	Black Orpingtons ...	87	1,010
*Nobby Poultry Farm	Do.	93	1,003
*T. Hindley	Do.	112	982
*Mars Poultry Farm	Do.	111	957
*Jas. Ferguson	Chinese Langshans ...	92	939
*D. Fulton	Black Orpingtons ..	91	928
R. B. Sparrow	Do.	120	928
*W. H. Reilly	Chinese Langshans ...	82	892
A. Homan	Black Orpingtons ...	108	874
Burleigh Pens	Do.	94	870
*F. W. Leney	Do.	92	851
*H. Puff	Rhode Island Reds ...	75	829
J. A. Cornwell	Black Orpingtons ...	97	799
*T. B. Barker	Do.	76	775
C. H. Singer	Do.	96	771
H. Ashworth	Do.	84	744
A. Gaydon	Do.	92	734
Total	...	7,128	64,523

* Indicates pen is being single tested.

RESULTS OF SINGLE HEN PENS.

Competitors.	A.	B.	C.	D.	E.	F.	Total.
LIGHT BREEDS.							
J. M. Manson	212	196	216	210	194	206	1,234
T. Fanning	211	188	200	215	200	213	1,227
E. A. Smith	189	185	210	190	179	202	1,155
W. Hindes	205	199	193	173	185	191	1,145
Dr. E. C. Jennings	189	162	189	180	179	210	1,109
Dixie Egg Plant	172	185	192	192	172	167	1,100
G. W. Hindes	195	180	193	170	161	171	1,070
Haden Poultry Farm	196	193	179	173	139	175	1,055
Range Poultry Farm	166	181	184	183	158	173	1,055
Quinn's Post Poultry Farm ..	170	173	181	203	165	161	1,053
B. Caswell	146	120	173	208	224	175	1,046
W. Becker	203	182	193	162	130	163	1,033
L. G. Innes	148	193	145	184	190	167	1,037
C. P. Buchanan	151	195	151	164	165	189	1,015
H. Fraser	140	189	195	174	123	183	1,004
J. J. Davies	154	163	173	172	157	166	985
Mrs. L. F. Anderson	177	188	150	164	138	152	969
Mrs. A. G. Kurth	196	168	169	158	118	154	963
W. Lyell	148	170	181	150	156	152	957
Thos. Taylor	168	130	139	181	182	135	935
Mrs. R. Hunter	144	121	167	153	157	160	902
O. W. J. Whitman	141	173	133	130	153	141	871

RESULTS OF SINGLE HEN PENS—*continued.*

Competitors.	A.	B.	C.	D.	E.	F.	Total.
HEAVY BREEDS.							
R. J. Holmes	212	213	231	187	246	164	1,253
E. F. Dennis	309	181	215	196	178	227	1,206
R. Burns	207	173	192	252	188	172	1,189
E. M. Larsen	196	201	214	174	200	172	1,157
W. Smith	162	198	188	164	204	188	1,102
A. E. Walters	195	160	193	176	175	191	1,090
E. Morris	172	166	183	181	204	128	1,034
Kelvin Poultry Farm	227	150	163	134	186	162	1,022
A. Shanks	86	143	213	170	191	207	1,010
Nobby Poultry Farm	168	144	145	166	187	193	1,003
T. Hindley	178	172	140	184	144	164	982
Mars Poultry Farm	143	197	194	126	120	177	957
Jas. Ferguson	162	209	127	134	155	152	939
D. Fulton	139	156	157	146	169	161	928
W. H. Reilly	133	127	178	169	127	143	892
F. W. Leney	111	136	152	186	123	138	851
H. Puff	165	130	141	164	96	133	829
T. B. Barber	128	135	118	124	146	124	775

CUTHBERT POTTS,
Principal.

POULTRY DISEASE.

"Anxious," Home Hill, Bowen.

Mr. J. Beard, Poultry Instructor, replies to your questions as follows:—Your fowls are apparently suffering from a severe form of "roup." When once this disease makes its appearance, it becomes contagious. It is a common disease, and one of the most deadly that poultry-keepers have to contend against. The disease can be readily transmitted, and may spread through a flock with great rapidity, unless strict preventive measures are taken to check its progress.

TREATMENT.

Examine all your birds carefully, and for any that are badly affected the axe is the best remedy. Quarantine all birds that are only slightly affected, and wash the head and nostrils thoroughly with a weak solution of boracic acid and warm water, using your finger and thumb to squeeze the nostrils out, and clean out the cleft of the top of the mouth with a feather. Then dry thoroughly and apply kerosene to the nostrils and cleft with a feather. This process must be continued until a cure is effected. Disinfect all houses and yards thoroughly with a strong solution of disinfectant.

PREVENTIVE.

Cut a kerosene tin in halves endways, which will give nine inches square of water surface. Supply their drinking water in this, and add one tablespoonful of kerosene twice a week, when the fowls show any signs of roup, and once a week in normal times. This remedy will destroy any nasal or internal disease germs, and is self-applied. Care should, however, be taken that no other water is within reach during the kerosene process.

Dairying.

NOTES ON THE METHYLENE BLUE REDUCTASE TEST.

R. B. TENNENT, N.D.D.

INTRODUCTION.

The study of milk enzymes has of recent years received considerable attention, much valuable work being carried out with a view to obtaining a fuller knowledge and a clearer conception of their various characteristics. Controversy has arisen on many important points concerning their action and effect, but until such points have been clearly established by conclusive experiments, it will be impossible to dogmatise on the subject.

Normal milk, as secreted by the healthy mammary glands of the cow, contains certain enzymes, the most important of these being—

(*a*) Peroxidase.
(*b*) Reductase (indirect).
(*c*) Catalase.
(*d*) Amylase.

That milk contains other proteolytic enzymes, such as lipase (a fat-splitting enzyme) and lactase, is claimed by different observers, but at present the evidence supporting such claims is not sufficiently conclusive to say definitely that such is the case.

The invariable presence of the abovenamed enzymes in milk forms the basis of different tests, and, as they are readily destroyed by heat, advantage is taken of their presence or absence in determining whether milk is raw or pastuerised (Peroxidase test).

It has long been known that if methylene blue be added to milk, the blue colouration produced could be destroyed by incubating the milk for some time, the period required varying considerably with the different samples of milk taken. That this phenomenon is due to bacterial activity is unquestioned, and efforts have been made to utilise it in measuring the bacterial content of milk, but the results have not been satisfactory, owing chiefly to the fact that no standard technique has been adopted, and that too much was hoped for in this test. As a means of determining the exact number and kind of organisms present in milk it is valueless, but as a simple test for obtaining an approximate idea of the general bacterial content, apart from the pathogenicity or otherwise of the organism, it has much to commend it.

HISTORICAL.

The reducing action of bacteria as indicated by the presence of reductase is no new observation. In 1843 Helmholtz in a series of experiments showed that putrefactive changes which were undiscernable by odour could be proved by discolouration of litmus colouring matter, and at a subsequent date his results were confirmed by many authors who proved this reducing action to be an attribute of many aerobic and anaerobic organisms. According to Dupetit and Gayon, the anaerobes are capable of forming ammonia from nitrates, while the *B. prodigiosus* and others form nitrites from nitrates.

Some authors, such as Spina and Wolff, use colouring matter which changes into leuco-compounds, as an agent for demonstrating the reductase process, but they become reoxidised from renewed contact with the atmosphere. The colouring substances used by them are—tincture of litmus, indigo blue, neutral red, thionin, &c. Others again (Kleet, Gosio) use metallic salts, such as selenite and tellunite, to render the reduction directly visible.

REAGENTS.

Shardinger's methylene blue reagent is at the present time most extensively used, and it is prepared by diluting 5 c.c. of a saturated alcoholic solution of methylene blue with 195 c.c. of water. He also recommends another reagent called "F.M.B." (formaldehyde methylene blue), which contains 5 c.c. saturated alcoholic solution of M.B. + 5 c.c. of 40 per cent. formaldehyde + 190 c.c. water. In each case one uses 1 c.c. of the reagent to 20 c.c. of milk heated to 45 degrees C.

The reduction is complete when the blue milk turns white. When the reaction occurs in the absence of aldehyde, it is now termed "direct reductase reaction," and in the presence of aldehyde, the "indirect reductase reaction."

THE TEST.

In making the test a control sample should be used for comparison of colour. After the addition of the reagent to the milk, the length of time elapsing from its addition until the milk turns white should be noted. If this occurs in less than three hours the milk is already "old." Here, however, "age" does not mean the length of time elapsing since the milk was drawn from the udder, but that the milk has "aged." Thus, milk produced under dirty conditions, imperfectly cooled, and transported in badly cleansed cans, "ages" more rapidly than that produced under hygienic conditions.

It is advocated by some that in making the test it is necessary to cover the sample in the reagent glass with boiled oil or kerosene, but there is no advantage in doing so.

A satisfactory method of determining the reduction property of milk is that recommended by Ernst. For each sample of milk ten small tubes are used, containing one, two, three, four, up to ten drops of M.B. solution respectively. Into each tube 5 c.c. of milk is added. After one-quarter, one-half, one, and two hours, &c., observations are made as to what extent the milk has been reduced. This method is quite simple, and eliminates the constant watching of the samples in order to detect the time when the reduction is complete, and by this method both time and degree are determined. If, for instance, a milk is reduced in three hours to tube 8, then the formula will be: R3 = 8. Good milk reduces the first two tubes only after two to three hours; fresh milk only after ten to eighteen hours.

OBSERVATIONS.

The reducing qualities of different organisms towards methylene blue undoubtedly vary. Jensen has carried out considerable researches in this connection, and has shown the reduction qualities of a series of organisms found in milk. He further proved that varieties of the colom group, staphlycocci mould fungi, and sarcina reduce rapidly, whilst *acid streptococci* do not decolourise the solution.

Arranged in order of the length of time, reduction takes place as follows:—

B. fluorescens non-liquefaciens	8 minutes
B. acidi lactici (Hueppe)	12 „
B. prodigiosus	10-15 „
B. fluorescens liquefaciens	13 „
B. coli communis	17 „
B. subtilis	30 „
B. mesentericus vulgatus	60 „
Streptococcus acidi lactici, Oidium lactis	not in 80 minutes.

From the above table it is obvious that milk contaminated with the excreta of cows or dirty straw, which contain *B. coli communis* and *B. subtilis*, respectively, will take a much longer time to react to the reductase test than milk containing numbers of *B. acidi lactici*.

Milk with a high bacterial content reduces methylene blue solution in a period of time directly in proportion to the numbers and kind present. Milk drawn from the udder in a sterile condition fails to reduce the M.B. even after a few days. According to Müller, freshly drawn and cleanly handled market milk requires ten, twelve, or more hours for reduction (mixing 10 parts to 1 part M.B.), whereas fresh market milk in cold weather requires six to nine hours, and in warm weather one to two hours.

At the end of the incubation period, when the bacteria commence to multiply, the time required for reduction amounts to from one to two hours. The addition to fresh milk of manure or sour milk hastens the time for reduction. Thus factors favouring bacterial growth hasten the reduction.

From the writer's own observations, he found that 10 c.c. of milk containing about 50,000 bacteria per c.c. failed to reduce 1 c.c. of M.B. solution in six hours.

With approximately—

250,000	bacteria,	reduction	took place in	5½ hours
500,000	"	"	"	3½ "
1,700,000	"	"	"	2½ "
10,000,000	"	"	"	70 min.
400,000,000	"	"	"	30 "
700,000,000	"	"	"	15 "

EFFECT OF ACIDITY.

There exists a direct relationship between the growth of bacteria and the production of lactic acid, the organisms converting lactose into lactic acid; hence there exists a certain connection between the degree of acidity of milk and the rapidity of reduction. Further, since the degree of acidity increases rapidly after the completion of the incubation period, a rapid reduction would be expected to follow the increase in the degree of acidity.

That such is the case has been proved by the experiments of Jensen, who observed that milk which reduced in one minute after twelve hours at 25 degrees C. had a degree of acidity of 36.

Milk reduced in—

5	minutes	after	12	hours	at	25	degrees	had a degree of acidity of .. 19
8	"	"	"	"	"	"	"	.. 20
6	"	"	"	"	"	"	"	.. 35
10	"	"	"	"	"	"	"	.. 22
1	hour	"	"	"	"	"	"	.. 15
½	"	"	"	"	"	"	"	.. 25.5
1¼	"	"	"	"	"	"	"	.. 11.5
2¼	"	"	"	"	"	"	"	.. 15
3¼	"	"	"	"	"	"	"	.. 9
6½	"	"	"	"	"	"	"	.. 8
12¼	"	"	"	"	"	"	"	.. 7

The writer made observations of the effect of acidity on the length of time required for reduction of the methylene blue, and his results are similar to those of Jensen.

The following table compiled by Ernst shows the results of the technique employed in testing milk, where the reduction number is understood to mean the

number of drops of methylene blue solution which in a given time were completely reduced by 5 c.c. of milk:—

Degree of Acidity.	After Twenty-four Hours at 20 Degrees.	Time Required for Reduction.	Reduction Number.
7.0	7.4	20 hours	0
6.2	8.6	20 „	0
6.0	10	20 „	0
6.0	9	20 „	4
7	10	20 „	0
6	24	4 „	2
6.4	26.5	8 „	10
6.5	26	8 „	6
6.2	24	8 „	8
6.2	27	8 „	6
6.8	23	8 „	4
6	14	8 „	4
7.8	30	6 „	4
6.5	28	2 „	2
7.2	32	1 „	2
6	34	1 „	2
6.2	38	1 „	10
8	40	5 „	10
10.5	26.4	0.5 „	10
6	30	6 „	2

The above numbers are the results obtained by him from a large number of samples of milk indiscriminately selected from a milk control station, and they go to show that milk which sours rapidly also reduces rapidly. It is to be noted, however, that there is no constant relationship between the values of acidity of milk after twelve and after twenty-four hours, nor with the values of fresh milk.

After milk becomes thoroughly sour, reduction practically ceases, and this in all probability is due to the fact that the acid formed inhibits the reduction power.

The addition of an alkali such as sodium carbonate restores the reduction properties. It may, on the other hand, be due to the "normal" milk organisms forming such a quantity of lactic acid that their growth is inhibited, thus allowing the *acid streptococci* or mould fungi to outgrow them.

EFFECT OF ANTISEPTICS AND HEAT.

The reduction power of bacteria may be inhibited or destroyed by such antiseptics as boric acid, salicylic, and formaldehyde. This effect can also be obtained by heating the milk for ten to thirty minutes at 80 to 100 degrees C., destroying, as it does, the bacterial cells.

TAINTED MILK.

It should be borne in mind that milk which would normally be condemned on account of its bad taints, such as "soapy milk," might possess quite a slow reducing power, provided that such a condition was not associated with extensive bacterial contamination from other sources. Although the bacillus causing "soapy milk" (*B. lactis Saponacei*, Weigmann) reduces rapidly, a comparatively small number of such organisms will produce the "soapy taint." Milk condemned on account of a taint does not then necessarily contain many of the taint-producing organisms; hence it does not follow that tainted milk will reduce rapidly.

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Plate 1a.—Picking Citrus Fruit to avoid Bruising.

PLATE 2A.—PICKING CITRUS FRUIT TO AVOID BRUISING.

The Orchard.

NOTES ON CITRUS CULTURE.

By SALVATORE SCERRI, Assistant Instructor in Fruit Culture.

In my visits to citrus orchards in the North Coast district, I have had to point out the great want of knowledge shown by many citrus-growers with respect to the management and working of their orchards. In very many cases the land has not been well prepared, the trees badly planted, the pruning has not been correctly done, and the cultivation of the land bad. In the various demonstrations I have given I have pointed these faults out, and have shown how they can be overcome.

In the first place, where the land has been badly prepared, it was not thoroughly and deeply worked before the trees were planted; therefore, the bottom soil was so hard that the roots of the young trees could not penetrate it. This is wrong treatment, as the bottom soil should be well worked, so that the roots can go well down into it.

In the second place, the trees have been badly planted. [*Note* 1.—A great mistake in the past has been the planting of citrus trees too shallow. The young trees should be planted in a basin, so that when the soil was eventually levelled it would be 6 in. above the point where the tree was bedded.] Not only have the roots been badly pruned and surface roots allowed to remain, but the main roots have not been set so as to encourage their going down into the soil, but have been allowed to grow along the surface where they are not wanted. [*Note* 2.—As regards the cutting away of surface roots, much care is required, because the root system is very hard to treat, and only one or two of them should be cut away every winter.]

In the third place, many of the young trees have been badly pruned at the start, as, instead of allowing only three main branches to remain to form the head, and these three branches having an upward and outward trend, a number of useless limbs have been left which are of no good to the tree, as they crowd the head and prevent the proper growth of these main limbs, which are needed to form the future tree.

This improper pruning at the start has given me a lot of trouble when pruning older trees, as I am frequently obliged to cut away a large number of useless branches that should never have been allowed to grow from the start.

If the young tree is given its correct shape in the beginning, and all crossing, useless, or superfluous branches—such as branches on or near the ground or growing towards the ground—are cut away as soon as they make their appearance, the tree will not require the heavy pruning now so often necessary when it gets older. The pruning out of the small wood at the right time can be done quickly and easily with a good sharp pair of pruning shears; but, if this is neglected, then those same branches will grow to a large size and need a strong chisel and a mallet to remove them.

In the fourth place, the cultivation is bad, the land between the trees being badly worked. If the land has not been well worked before the trees were planted, the roots come to the surface; and orchardists are afraid to cultivate the land deeply for fear of injuring the roots. This is all wrong, as surface roots are not good in every climate. The surface soil must be kept well and deeply worked, so as to have a good soil mulch to keep in the moisture and keep the trees growing during dry weather. The land must be well ploughed between the trees with a disc plough and dug underneath them, which will cut and not tear any roots it touches, and the ground so ploughed and dug must be kept well and deeply stirred to retain the moisture.

Neglected orchards require severe treatment to get them into proper shape. [*See Note* 2.] Surface roots must be cut away, the soil well worked up, and the top of the tree reduced so as to correspond with the smaller root system. There must be a proper balance between roots and top. Once the trees are in proper shape, they must be kept so. A well-kept orchard will pay, but a neglected one won't.

Many trees are worked on wrong stocks. The common lemon should not be worked as a stock, as the trees worked on it won't last. The Seville and sweet orange stocks are much better, as trees worked on these will last for many years. Grow healthy trees on well-prepared and well-cultivated land, and prune them properly; and you won't want to do so much spraying. I do not consider too much spraying good for trees.

Where trees have been treated by me in the manner I have described, they are now bearing much heavier crops than those that have not been treated, proving the value of proper pruning and the proper working of the land. Not only do many growers neglect their trees and orchards, but they handle the crop very badly. It is often carelessly picked and badly handled; and, in order to show the methods in use in Malta, I have had a picking ladder fitted with Stemp's patent and picking baskets specially made for demonstration purposes. The illustration herewith shows how the ladder is made, and how the picking basket is fixed, either on the top of the ladder or hung under it in a convenient position to be filled by the picker. The baskets are padded so as to prevent the fruit from being bruised, and the fruit is all cut from the tree, a small portion of the twig to which the fruit is attached, and which is of no further use, being removed, and this bit of twig is cut off before packing the fruit; so that the gathering of the fruit and the pruning of the outside of the tree are done at the same time, thus saving time and labour.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF DECEMBER, 1919, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING DECEMBER, 1919 AND 1918, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Dec.	No. of Years' Records.	Dec., 1919.	Dec., 1918.		Dec.	No. of Years' Records.	Dec., 1919.	Dec., 1918.
North Coast.	In.		In.	In.	*South Coast*—continued:	In.		In.	In.
Atherton	7·68	18	1·13	4·12	Nambour	6·32	23	1·13	3·14
Cairns	9·43	37	1 01	4·94	Nanango	3·61	37	0·43	1·83
Cardwell	8·59	47	0·73	3·90	Rockhampton ...	4·41	32	0·39	2·91
Cooktown	7·20	43	1·43	4·71	Woodford	5·34	32	2·40	1·86
Herberton	5·66	32	0·77	3·81					
Ingham	7·37	27	1·26	5·21					
Innisfail	12·56	38	1·34	4·73					
Mossman	13·48	11	2·59	10 97	*Darling Downs.*				
Townsville	5·72	48	0·68	0·80					
					Dalby	3·14	49	2·40	3·84
					Emu Vale	3·52	23	2·47	3·52
Central Coast.					Jimbour	3·13	31	1·86	2 32
					Miles	2·47	34	0·84	0·56
Ayr	3·82	32	0·93	2·31	Stanthorpe ...	3·48	46	0·93	3·27
Bowen	4·45	48	0·09	0·85	Toowoomba ...	4·17	47	1·27	2·33
Charters Towers ...	3·60	37	0·22	0·35	Warwick	3·44	32	1·62	2·57
Mackay	6·99	18	0·14	0·25					
Proserpine	9·17	16	0·27	1·57					
St. Lawrence ...	4·38	48	0·03	0·43	*Maranoa.*				
South Coast.					Roma	2·29	45	1·73	0·27
Biggenden	4·32	20	0·45	0·74					
Bundaberg	4·38	36	0·05	1·38	*State Farms, &c.*				
Brisbane	4·91	68	1·58	0·88					
Childers	4 98	24	0·22	0·70	Bungeworgorai ...	2·58	5	1·29	0·43
Crohamhurst ...	6 69	26	0·45	3·02	Gatton College ...	3·39	20	1·82	1·57
Esk	4·27	32	2·01	1·54	Gindie	...	...	0·52	Nil
Gayndah	3 78	48	0·53	1·25	Hermitage ...	2·84	13	1.73	3 31
Gympie	5·79	49	0·06	0·69	Kairi	9·35	5	0·79	5·61
Glasshouse M'tains	7·13	11	1·26	1·92	Sugar Experiment Station, Mackay	8·62	22	4·04	0·33
Kilkivan	4·20	40	0·03	1·38	Warren	3·76	5	Nil	2·10
Maryborough ...	4·48	48	0·10	2·24					

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for December this year, and for the same period of 1918, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND, State Meteorologist.

Tropical Industries.

THE CULTIVATION OF SUGAR-CANE IN QUEENSLAND.

BY HARRY T. EASTERBY, General Superintendent, Bureau of Sugar Experiment Stations.

PART VI.

CANE CULTIVATION ON OLD LANDS—*continued.*

IRRIGATION AND APPLICATION OF MANURES.

IRRIGATION.

The climatic variations in Queensland from year to year are often so great that canegrowing is only certain in those districts possessing a high average rainfall. Districts with an average rainfall of 50 inches and under suffer exceedingly during dry spells, and irrigation would prove highly payable in such localities.

At the present time the only canegrowing district that uses irrigation water to any extent is the Lower Burdekin, situated some 40 to 50 miles south of Townsville. On the north side of the Burdekin River irrigation has been practised for a number of years, the plants used being the property of the farmers. Water is found at shallow depths, and is easily obtainable by sinking spearheads. On the south side of the river the Government are installing a complete system, which will be available to growers of cane. Wells are being sunk and the pumps will be electrically driven from a central power-house.

The cost of applying irrigation water on the Lower Burdekin is comparatively high, even though the most economical method is used. Consequently, there is a tendency to do as little of it as possible, and, in many instances, to postpone the application if rain appears probable. This frequently leads to the suffering of the crop should rain fail to fall, and the irrigation has not been carried out.

Water is not applied scientifically to cane crops on the Lower Burdekin, so that the greatest efficiency is not secured. This, however, is largely due to the high cost of application. The method of irrigating is to run the water in shallow furrows between the cane drills, usually made with the disc harrow known as the Cotton King Cultivator. The water is generally conveyed by fluming to the main ditch running on the headland at right angles to the cane rows. The water is then admitted to the channels between the cane, but as no attempt has been made to grade the land a great deal of water is often wasted.

In Hawaii the water is usually applied directly in the furrow or drill in which the cane plants are growing. The preparation of the

land is more expensive, as it is laid out for irrigation according to the land contour, and the drills are cut into short sections so as to secure an even distribution. This method secures the largest economy of water. In the Queensland system, as practised at Ayr, it is not generally possible to evenly distribute the water over all the land, consequently some of the area goes short while other parts obtain too much. This system, therefore, involves the greatest waste of water, but is the cheaper as far as actual application is concerned. This is, of course, a vital point in the cultivation of cane in Queensland, where the costs of labour are so high. It is usual to only make one or two, or at most three, applications of water on the Lower Burdekin, but these are large in volume, running up to six inches.

In Hawaii, on the contrary, the applications are smaller, but far more frequent, ranging from the equivalent of half-an-inch of rainfall per week, to three inches or more, as the crop makes greater demands upon the soil. These irrigations are carried on until the crop nearly reaches maturity; they are then stopped, so that the absence of water may have the effect of ripening the cane crop. With such a system the application of manures can be carried out in the most satisfactory manner, and the combined use of water and fertilisers renders the cane crops of Hawaii the heaviest in the world, while the production of sugar per acre is also higher than elsewhere.

As irrigation for cane must eventually play a large part in sugar production in the drier cane areas of the State, the matter will ultimately have to be taken in hand, so that the water may be applied in the most economical way, and no doubt the Hawaiian system, which has proved so successful, will be tried. It is a noteworthy fact that much larger crops can be grown with irrigation properly applied in dry areas than on lands where the rainfall is plentiful.

THE APPLICATION OF MANURES.

The manurial elements needed in the growing of successful cane crops are nitrogen, potash, and phosphoric acid. These are usually supplied in the following fertilisers:—

Nitrogen in—

Nitrate of soda contains about		15 per cent.	nitrogen.
Sulphate of ammonia	„	20	„
Nitrate of lime	„	12½	„
Nitrolim	„	18	„
Dried blood	„	11	„
Meatworks manure	„	3 to 7	„

Potash in—

Sulphate of potash contains about 52 per cent. potash.

Phosphoric acid in—

Superphosphate contains about		16	per cent. phosphoric acid.
Rock phosphate	„	18	„
Guano	„	15	„
Thomas phosphate	„	17	„
Meatworks manure	„	17	„
Bonedust	„	20	„
Basic superphosphate	„	19	„

Phosphoric acid is found in a readily soluble form in superphosphate, it being practically all water-soluble in that material. In the other forms shown above, the phosphoric acid may be partly citrate soluble, and partly citrate insoluble. The following explanation of these terms is taken from a pamphlet by the Agricultural Chemist (Mr. J. C. Brünnich) :—

"In bones, and in most of the mineral phosphates, phosphoric acid exists in combination with lime, in the form of a calcium phosphate: tricalcic phosphate, which is insoluble in water and in citric acid solutions, but soluble in mineral acids. On account of this insolubilty the action of bone manure and mineral phosphates is exceedingly slow, and may extend over many years. The finer the bones or the phosphates are crushed or powdered the quicker will be the action, and for this reason the fineness of the bone meal is of importance, and should be stated.

"When strong sulphuric acid is allowed to act on this insoluble tricalcic phosphate, part of the lime combined with the phosphoric acid is withdrawn, lime sulphate or gypsum being formed, and the phosphoric acid is left in the form of monocalcium phosphate.

Bone phosphate or tricalcic phosphate. + Sulphuric acid. = Gypsum. + Monocalcium phosphate or superphosphate.

"This new compound is soluble in water, and therefore readily available to the plants, but on account of the special process of manufacture it is the most expensive form of phosphoric acid in our fertilisers. The superphosphate is generally manufactured from steamed bones, bone ash, and mineral phosphates. Mineral phosphates containing a high amount of iron or alumina are not suitable for the manufacture of superphosphates, because these bases readily recombine with this acid phosphate, to form again insoluble phosphates, called reduced or reverted phosphates. A similar change would take place if lime were added to superphosphate, and also in soils containing a large amount of lime, a dicalcium phosphate may be formed, which is insoluble in water, but soluble in citric acid solutions. Another form of a lime phosphate is found in basic slag or Thomas phosphate—namely, tetracalcium phosphate, which also is insoluble in water, but soluble in saline solutions, particularly such which contain salts of citric acid. These last two compounds are, therefore, classed as citrate soluble phosphoric acid, which is fairly readily absorbed by the plant roots, and, therefore, comes close in its value to the water-soluble phosphoric acid. Basic slag is an artificial product, and should be ground as fine as possible, and a good sample of this fertiliser should

nearly all pass through a sieve having 100 meshes to the linear inch. Thomas phosphate is one of the cheapest and best sources to supply phosphoric acid; it is of particular value to sour lands, deficient in lime but rich in humus."

HINTS ON PURCHASING AND USING MANURES.

1. Do not take delivery of manures unless they are accompanied by an invoice certificate, containing the guaranteed percentage of the article purchased, or, in the case of a mixture, the guaranteed percentages of the different ingredients.

2. Do not accept delivery of bags of fertiliser that are not labelled or branded.

3. It is much wiser not to buy fertiliser of low grade, as you may have to pay freight on a lot of useless material.

4. Always see you obtain the manure you order.

5. Do not give a higher price per ton than the registered price under the Fertilisers Act. This may be seen periodically in the "Agricultural Journal."

6. Do not buy more manure than you intend using, as fertilisers do not improve with keeping. If possible, mix your own fertilisers, as you can vary the proportions to suit your own requirements.

8. Always remember you want to manure the crop—not the land.

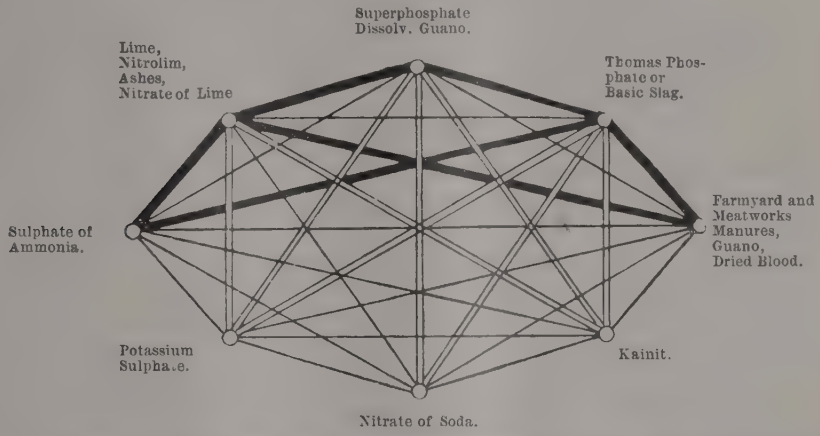
9. Prevent bags of fertiliser from getting wet. This always leads to loss, and frequently sets the manure in hard lumps difficult to break up.

10. Finally, always bear in mind that fertilisers give the best results on well-tilled soils, and that they also need moisture in the soil. Applying fertilisers in time of drought is waste of manure.

Under the Fertilisers Act it is required that the dealer shall at the time of sale, or before delivery, give to the buyer an invoice certificate signed by the seller or his agent, stating the full name and place of business of the dealer; the name, trade mark, brand, or sign used to mark packages containing such fertiliser, and used to identify such fertiliser; the quantity or net weight of fertiliser comprised in the sale; the composition of the fertiliser, setting forth the proportion per centum in which such fertiliser contains the following ingredients:—Nitrogen, phosphoric acid, potash, and lime, and the respective forms in which they respectively occur; and, in the case of bonedust, basic slag, agricultural lime, &c., the percentage of coarse and fine material.

Furthermore, every dealer who sells fertiliser, which term includes offering or exposing for sale and having in possession for sale, shall securely affix to each package a printed label, clearly and truly certifying:—The number of net pounds of fertiliser in the package; the figure, trade mark, or sign under which the fertiliser is sold; the chemical composition of the fertiliser, in the same manner as stated on invoice certificate; and the state of fineness for certain fertilisers.

In mixing fertilisers, care must be taken not to bring ingredients together which would lead to decomposition or loss of some part of the manure. Thus, should lime be mixed with sulphate of ammonia, a loss of nitrogen would take place. A simple guide for the mixing of manures is given in the accompanying diagram:—



Manures joined by a *heavy black line* should *never be mixed* together; those connected by a *double line* must only be *mixed immediately before use*; and those joined by a *thin single line* may be safely *mixed* together *at any time*.

Before applying fertilisers, it would be wise to send samples of the soil of the farm (not less than 5 lb. in weight) to the General Superintendent, Bureau of Sugar Experiment Stations, Brisbane, for free analysis and advice, accompanied by a form giving full particulars. These forms may be obtained from the office of the Bureau in Brisbane, but many secretaries of the different Farmers' Associations have supplies.

In the absence of an analysis of the soil, the following mixtures have generally been found of great benefit to cane crops:—

No. 1.

200 lb. nitrate of soda per acre.
100 lb. sulphate of potash per acre.
300 lb. superphosphate per acre.

No. 2.

250 lb. sulphate of ammonia per acre.
100 lb. sulphate of potash per acre.
300 lb. superphosphate per acre.

On a percentage composition this mixture would approximately contain—

Nitrogen	7·7 per cent.
Potash	7·7 „
Water-soluble phosphoric acid	7·0 „

No. 3.

Nitrate of soda	200 lb. per acre.
Sulphate of potash ..	150 lb. „
Meatworks fertiliser ..	300 lb. „

No. 4.

Nitrate of soda	200 lb. per acre.
Sulphate of ammonia ..	200 lb. „
Sulphate of potash ..	150 lb. „
Superphosphate	300 lb. „

It may be asked which of these mixtures is the best to use. No. 1 is a fairly cheap mixture. No. 2 contains somewhat more nitrogen and is a well-known formula sometimes sold as "Three Sevens" or "Cane Mixture." No. 3 would be suitable for Northern lands, while No. 4 is a more expensive fertiliser, but it would yield correspondingly higher crops on lands with a good rainfall.

In all these fertilisers, one-half of the nitrogen should be applied with the remainder of the manure as a first dressing, in drills on each side of the cane, and then covered; and the balance of the nitrogen should be applied as a top dressing at an interval of about two months.

Nitrate of soda is easily leached from the soil; hence it should not be applied during a heavy wet season. It is a great plant stimulant, and has frequently been found to add such strength and vigour to cane plants, that it strongly aids in obtaining other mineral food, such as potash and phosphoric acid from the natural reserves in the soil. Nitrate of soda will often show its effects in a week or two, producing a rich, dark-green colour in the foliage, and cause a marked improvement in the growth of the cane.

Nitrogen, in the form of sulphate of ammonia, is not so quick in action as in nitrate of soda, while nitrogen in dried blood, bonedust, and meatworks manure is still slower in action, as they require chemical changes to convert them into nitrate, so as to become available to the plant.

Meatworks, in the wetter cane areas of North Queensland, is often preferred to superphosphate as being less soluble. It can be substituted for superphosphate in any of the above mixtures where desired.

As a rule, considerably more benefit is got from the manuring of ratoons than from the manuring of plant cane, and this experience is common. This is strikingly shown in the following summary of experiments carried out at Mackay:—

PLANT CROP.			FIRST RATOON CROP.		
Manures.	No Manures.	Difference.	Manures.	No Manures.	Difference.
50·7	47·4	3·3	42·4	31·7	10·7

SECOND RATOON CROP.			THIRD RATOON CROP.		
Manures.	No Manures.	Difference.	Manures.	No Manures.	Difference.
38·8	24·1	14·7	35·9	19·8	16·1

The above are in terms of tons of cane per acre.

The manures applied in the above cases were a mixture of nitrogen, potash, and phosphoric acid.

It is not recommended that mixed fertilisers should be placed in the drill with the cane plants. As soon as the cane is about 18 inches high, drills 4 to 5 inches deep should be drawn about 10 inches from the young cane on each side of the row, and the fertiliser is put into these drills and then covered, or a manure distributor can be used. Both sides of the row, however, should be treated. If nitrogenous fertilisers alone, such as nitrate of soda and sulphate of ammonia, are being used, they can be applied on the surface of the soil near the cane. Organic forms of nitrogen, such as meatworks and blood manures, requiring the action of soil organisms to render them available, should be placed in drills and covered.

For ratoons, the manures can be applied while working the interspaces. They may be dropped in the furrow ploughed away from the cane, and then covered.

For the continued successful use of artificial fertilisers, the land should not be acid in reaction. Considerable risk is involved in the continued use of manures such as sulphate of ammonia, sulphate of potash, and acid phosphates, *unless lime dressings have been previously made.*

On given soils, particularly on some of the red volcanic type, better results from the use of organic fertilisers, such as bonemeal, blood manure, meatworks manure, &c., have been realised. Megasse ash, molasses ash, and filter press cake should all be availed of when they can be procured. The latter should be ploughed in, some three or four months before the cane is planted, and the same may be said regarding the application of molasses when used as a manure.

Sugar-cane removes varying amounts of the vital elements from the soil. It is estimated, from analyses of the total cane plant (except roots) made in the Agricultural Laboratory, that the variety known as Clark's Seedling, 16 months old, took from the soil 163 lb. of potash, 83 lb. of phosphoric acid, and 96 lb. of nitrogen, while the variety known as Badila, of the same age, took out of the land 139 lb. of potash, 44 lb. phosphoric acid, and 107 lb. of nitrogen.

(To be Continued.)

NOTES ON THE NORTHERN SUGAR DISTRICT.

The General Superintendent of the Bureau of Sugar Experiment Stations has received the following report from the Field Assistant (Mr. J. C. Murray):—

Throughout the month the districts of Cairns, Herbert River, Ayr, and Bowen have been visited, and as many farms as possible inspected.

CAIRNS.

Crushing operations were in full swing here at the beginning of the month, with expectations of another fortnight's work. The season's run has been fairly successful, the industrial questions having been well and thoughtfully handled. Good tonnages of cane have been attained with fairly high percentages of sugar. Grubs and other cane pests continue to exercise the minds of most of the growers; but, in

spite of these and other drawbacks, such as very dry weather conditions, farmers should consider themselves fortunate, compared with the lot of sugar-producers south of the tropics this year.

As usual in the Cairns area, cane-growers are devoting much time and labour to intensive cultivation and the reviving of exhausted lands. This example could be well followed by a great many other districts where cane lands are rapidly becoming exhausted through lack of green manuring and liming. Naturally, this latter work is difficult to properly carry out, but even a little done annually would have an excellent effect.

With regard to varieties growing in the Cairns district, the only ones not noted in previous reports, and which are doing fairly well, are two canes imported from Fiji by the Colonial Sugar Refinery Company—viz., "Pompey" and "Remus." They appear, as far as can be judged at present, to be vigorous growers. With regard to others growing, Badila is still the principal cane. Both this and Clark's Seedling have been giving very satisfactory results and will be difficult to replace. Q. 813 and Q. 855 are canes that will probably give satisfaction in these areas if they are tried in the field.

Taking the district right through, the prospects for next year are good, especially if reasonable rainfalls occur to give the early plant crop a chance.

HERBERT RIVER.

The keynote of complaint here is lack of rain. There is no doubt, for a place with an average rainfall like the Herbert River, that the weather conditions have been extraordinary. Yet, in spite of this, the prospects for next year are good, especially with regard to the early plant crops of Clark's Seedling and Badila. The ratoons as yet in most canes are fairly green and strong; and, although the soil is very dry and baked on the surface, there is yet a fair quantity of moisture in the intermediate strata and the subsoil.

Crushing and cutting operations have been proceeding smoothly, with the exception of a machinery mishap at Macknade Mill.

Many of the growers at present are paying more attention to the question of liming than hitherto; and there are prospects that, in the near future, this will be carried on vigorously.

With regard to varieties growing, the principal ones are Badila and Clark's Seedling. Small quantities of 24 B and 1,900 Seedling are being grown; also D 1135. Another cane (H.Q. 409) is a variety that will probably justify planting; it ratoons well, has a high sugar content, and, generally speaking, displays characteristics that should make it of value to the farmer.

Considerable quantities of meatworks manure are being used for fertilising purposes with a fair amount of success. While this manure may benefit the growing cane in some instances, it by no means follows that meatworks manures are ideal for all the Herbert River soils. Farmers would be well advised before using artificial manures to get an analysis made of the soil, or, if they have already done this, to carefully study the report.

AYR.

Irrigation was in full swing at Ayr during November, and some very fine crops of cane were being cut.

The percentage of sugar also compares very favourably with other districts. There can be very little doubt that these results are obtained through the successful grappling with the irrigation problem. There are no finer examples of growing cane to be found than some of the irrigation Badila, near Plantation Creek.

There are several growers who possess irrigation plants with about 100,000 gallons per hour capacity; and the following, with regard to the weekly cost of a 120,000-gallon per hour plant, may be of interest:—

	£	s.	d.
Fuel	1	17	0
Oil	0	10	0
Wages	5	0	0
Depreciation	1	0	0
Total	£8	7	0

This is for a working week's continuous pumping.

This pump could irrigate about 8 acres per day to the equivalent of about 3 in. of rain. Of the varieties growing in the Ayr district, Badila and Clark's Seedling are finding the most favour. The Goru canes are still grown fairly extensively.

Of the N.G. cane distributed by Mr. McKenzie this year, the following are out on the farms growing:—N.G. 89, 165, 164, 141, 103; also, Q. 903, 855, and 813.

It is probable that, out of all these, the last-mentioned is the most suitable for the Ayr district.

Good strikes of cane have been obtained by some farmers this year, after using second ratoon standover cane for plants.

This is risky, and would result more often, probably, in failure than success.

Some of the cane is still suffering from a very severe frost last July. A lot of the frosted cane died, but some has recovered and is doing fairly well.

Farmers in the Ayr district are keen on agriculture and experiment work, and eagerly look for any information on their subjects that will benefit them. Numbers of growers are devoting much time to the question of reviving old lands and liming. Advice on the matter was frequently given and is being acted upon.

Cane pests are giving the farmers in the Ayr district very little trouble this year. Coots are causing a little worry in some places near the water, but other pests at present are a negligible quantity.

BOWEN.

Only mixed farming is going on around Bowen at present. Tobacco, citrus fruits, legumes, and cotton are all absorbing the growers' interests. Some farmers have small areas of Badila and Clark's Seedling, but the consensus of opinion is that, unless they can get a small mill there is nothing in sugar-growing. This is true as matters stand at present, and it also is very unfortunate because the Bowen soil will produce very good crops of sugar-cane. The farmers say that rail facilities are unsatisfactory, and sometimes a promise of trucks for cane freights is forgotten altogether.

REPORT ON CANE PLANTS DISTRIBUTED BY THE BUREAU OF SUGAR EXPERIMENT STATIONS, 1919.

The Field Assistant to the Bureau of Sugar Experiment Stations (Mr. J. C. Murray), reporting to the General Superintendent upon the recent free distribution of cane varieties from the Variety Plot established by the Sugar Bureau upon the farm of Messrs. H. Ruge and Sons, at Proserpine, states:—

Forty farmers obtained plants, about 3 tons being distributed.

The varieties given out, together with their percentage of commercial cane sugar, were as under:—

Per Cent. of C.C.S.	Per Cent. of C.C.S.
Q. 813 test 14.2	N.G. 94 test 10.9
N.G. 123 test 12.2	N.G. 87 test 15.0
N.G. 103 test 12.9	N.G. 102 test 13.0
N.G. 161 test 15.7	N.G. 141 test 15.0
N.G. 88 test 8.2	N.G. 164 test 11.8
N.G. 130 test 11.9	N.G. 81 test 10.3
N.G. 147 test 14.5	N.G. 83 test 15.7
N.G. 89 test 17.0	N.G. 165 test 14.8

Of these varieties, from observations made and opinions obtained from growers, it is probable that Q. 813 is the best variety right through, although for early planting purposes N.G. 161 appears to be very satisfactory. N.G. 89 is also a good cane, striking and stooling well with a high percentage of sugar.

BREEDERS OF PUREBRED STOCK.

Name of Owner.	Address.	Number of Males.	Number of Females.	Herd Book.
DAIRY BREEDS—AYRSHIRES.				
W. C. Smith	"The Haven," *via* Goomeri	1	5	Ayrshire Society of Queensland, No. 456.

Botany.

BOTANICAL NOTES.

By C. T. WHITE, F.L.S., Government Botanist.

(A)—DESCRIPTION OF A NEW VARIETY OF THE RED CEDAR.

Order MELIACEÆ.

Cedrela Toona, Roxb., var. **vestita**, n. var.*

Differs from the type and other Australian forms in the leaves being densely velvety pubescent on the under surface with rather long hairs.

Habitat: Parishes of Dundas and Byron (Warwick District). Assistant Forester *W. E. Moore.*

C. De Candolle, in his "Revision of the Indo-Malayan Species of Cedrela" (Records of the Botanical Survey of India, vol. III., No. 4), describes the Common Australian Red Cedar as *C. Toona*, Roxb., var. *australis* (F.v.M.), C. DC. In the same publication he describes several extra-Australian varieties of *C. Toona* as possessing pubescent or puberulous leaflets, but none seem to quite agree with the present plant. Mr. Moore's specimens are in fruit only, and it is quite possible that the flowers, when available, may show some further differences from the two previously described Australian varieties, viz., vars. *australis* and *parviflora.*

(B)—ON A HALORAGIS NOT PREVIOUSLY RECORDED FROM QUEENSLAND.

Order HALORAGEÆ.

Haloragis odontocarpa, F. v. M. Toothed Raspwort. (Plate 1.)

A tall herb with hairy stems and leaves. Leaves alternate, narrow lanceolate, tapering at the base to a slender petiole, 1-2½ inches long, edges coarsely toothed. Flowers in clusters along a slender raceme lengthening in fruit to nearly 1 foot; calyx lobes short, broadly ovate, acute, edges long-ciliate; petals, 4, linear, scarcely 1 line long; stamens, 8; styles and ovules, 4; fruit nearly 2 lines long, muricate, prominently 4-angled or almost winged.

Habitat: Charleville, *F. W. Barlow*; Murweh (*coll.?*).

Distribution.—New South Wales and Victoria.

Local Names.—In the "List of Vernacular Names for Victorian Plants" drawn up by a Committee of the Field Naturalists' Club of Victoria the name of "Toothed Raspwort" is suggested. In Western Queensland it goes under the name of "Spinach" and "Nettle," both of which are, however, applied to a number of native plants. In America, species of *Haloragis* are generally known as "Poverty Weeds."

Uses.—In forwarding his specimens, Mr. Barlow states: "A very good and useful herbage, common in good winters in this District (Charleville) and the western part of the Maranoa district. It is known as "Spinach" about Charleville and "Nettle" in the Nebine country, but it is neither a nettle nor a spinach. It is a good cattle and horse fodder."

SOME OBSERVATIONS ON WEEDS AND SCRUB UNDERGROWTH EATEN BY STOCK.

By W. D. FRANCIS, Assistant Botanist.

Towards the end of December, 1919, the writer visited Kin Kin, and took the opportunity to make some notes on the plants that were eaten or were avoided by stock. The subject is of especial interest on account of the dry weather which prevailed and the shortage of the usual wholesome herbage—conditions which cause stock to feed on other vegetation of whose fodder value in many instances comparatively little is known.

Kin Kin is a large dairying district of the North Coast Line situated coastwards of Cooran. During the past twelve years some thousands of acres of rich scrub land have been felled and cleared, and grassed chiefly with paspalum. As the plants referred to flourish in many other districts of the North Coast Line, while

**Cedrela Toona*, var. *vestita*, C. T. White; varietas nova foliolis subtus dense velutino-pubescentibus.

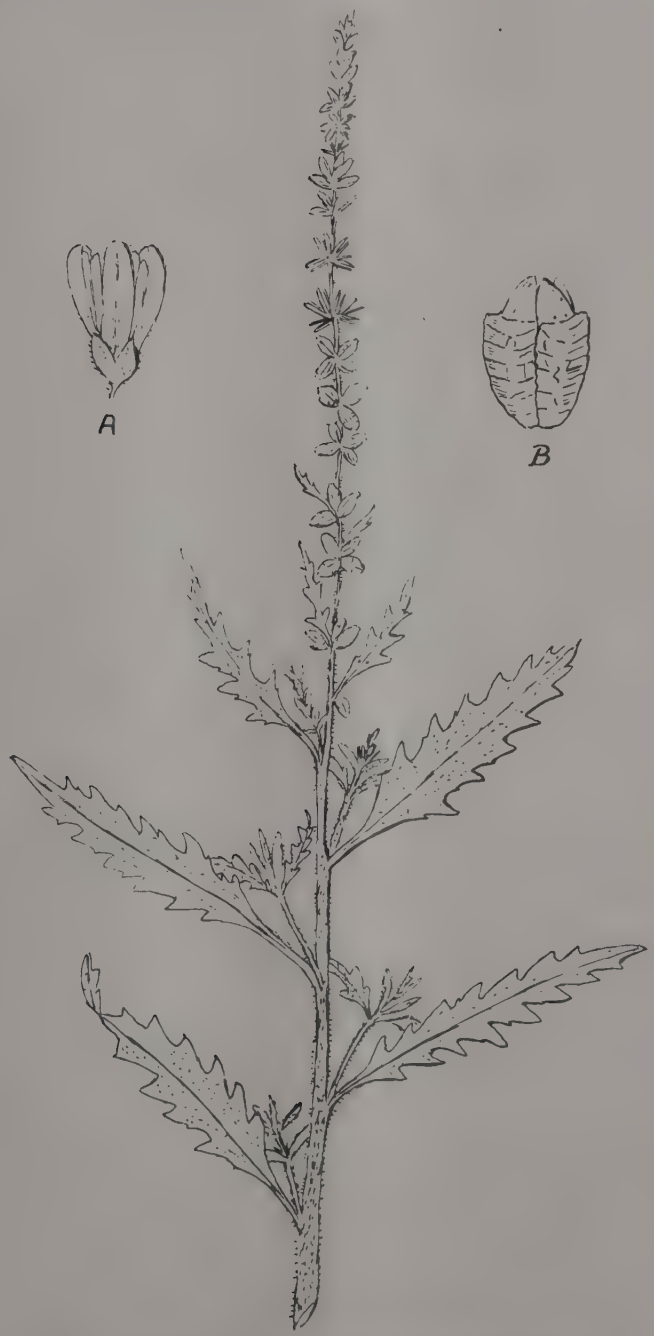


PLATE 1.—TOOTHED RASPWORT (HALORAGIS ODONTOCARPA).
A useful fodder herb.
A. Male flower. B. Fruit (both enlarged).

some of them are found farther North, the following observations are applicable, to a certain extent, to a much wider area than the district in which they were made.

The undergrowth mingled with the pasture in the partly-cleared areas consists of two classes: (*a*) introduced weeds, such as Lantana; and (*b*) the native shrubs and trees, such as Brown Kurrajong.

INTRODUCED WEEDS.

THE SCOTCH THISTLE (*Cnicus lanceolatus*) is generally very abundant in partly-cleared scrub land. Its prickly flower-heads are eaten by stock, especially horses. Many large plants which had been entirely denuded of their flowering shoots by stock were frequently seen. The plant has a good reputation as a fodder, and appears to keep horses in very good condition; the glossy coats of some of the horses at Kin Kin being attributed by their owners to this plant.

THE LANTANA (*Lantana camara*).—During the dry weather stock evidently fed upon this plant to a considerable extent without any ill effects.

WHITE COTTON (*Gomphocarpus brasiliensis*) is generally avoided by stock.

RED COTTON (*Asclepias curassavica*).—A suspected poisonous plant. Generally avoided.

WILD TOBACCO (*Solanum auriculatum*).—This common pest, which is poisonous, is rarely eaten. Occasionally horses eat a few shoots of it.

INK WEED (*Phytolacca octandra*) is seldom eaten except when a very young plant of a few inches, at which stage it is often fed upon.

NATIVE PLANTS.

BROWN KURRAJONG (*Commersonia echinata*).—Often very plentiful in partly cleared areas, and is a great favourite with stock. The trees, which are often abundant on timber tracks in the unfelled scrub, are cut down for feed.

WATTLE OR SALLY (*Acacia implexa*) (Plate 2).—A common tree in cleared and partly cleared areas of scrub land, whence it spreads from the Eucalyptus forests. The trees are cut down as fodder, when the leaves are readily eaten. The species has a good reputation as a substitute for herbage. As it is abundant throughout the districts of the North Coast Line, it may be desirable for stockowners to be able to identify it, and for that purpose a figure of the leaves, flowers, and pods accompanies this article. Its bark is brown in colour and deeply wrinkled or fissured. As several species of Acacia bear pods which contain a poisonous saponin, it may not be advisable to allow stock to eat the pods of this tree. The subject of the supposed poisonous property of Acacia pods is under review.

ROUGH-LEAVED FIGTREE (*Ficus stenocarpa*).—Eaten a little. The leaves of the Moreton Bay Fig (*Ficus macrophylla*) and of a figtree resembling it in appearance, *Ficus Watkinsiana*, which is very common on the North Coast Line, are eaten by stock as they fall from the trees.

WILD PEACH (*Trema aspera*) is extensively eaten by stock. It is reputed to be harmful, but very few losses, if any, have been caused by it at Kin Kin.

NATIVE TAMARIND (*Diploglottis Cunninghamii*).—The leaves are rarely eaten, but the ripe fruits, which are very acid, are greedily eaten by pigs, who will often travel some distance in search of them, and daily revisit the trees for the fruit as they ripen and fall to the ground.

DEVIL'S FIG (*Solanum torvum*).—A large prickly shrub. Eaten slightly.

BEANTREE; BLACK BEAN (*Castanospermum australe*).—The pods are poisonous and the leaves suspected to be poisonous. Rarely eaten.

CUDGEREE (*Flindersia Schottiana*).—Rarely eaten.

CORKTREE (*Duboisia myoporoides*).—Poisonous. Rarely eaten.

TAPE VINE (*Stephania hernandiaefolia*).—Poisonous. Rarely eaten.

Panax Murrayi, sometimes called "Umbrella Tree," is a slender tree with a palm-like crown of leaves and a soft, light-coloured wood. Rarely eaten.

Mallotus ricinoides, sometimes erroneously called "Castor Oil Plant," is a common shrub with a large leaf like the Broad-leaved Nettle. Rarely eaten.

Mallotus claoxyloides.—Rarely eaten.

Mallotus philippinensis.—Rarely eaten.

Tabernaemontana orientalis.—A common shrub with forked branches and fairly large, strongly perfumed, white flowers, sometimes called "Wild Jasmine." Rarely eaten.

Cryptocarya australis.—Suspected to be poisonous. Rarely eaten.

Callicarpa pedunculata.—A common shrub with opposite leaves and dense bunches of very small purple fruit. Rarely eaten.

Legnephora Moorei; A Vine.—Poisonous. Rarely eaten.

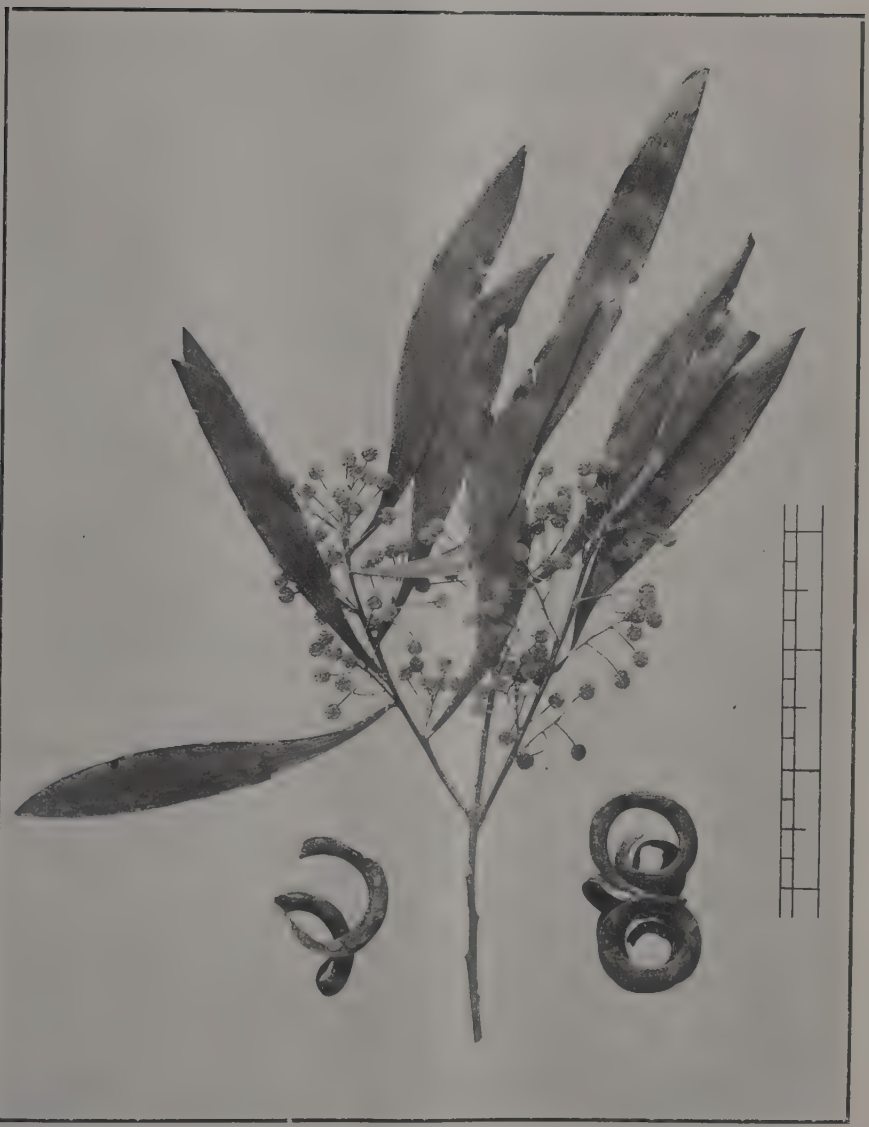


PLATE 2.—ACACIA IMPLEXA.
A useful Fodder Wattle.
(The measurement alongside represents inches and quarters of an inch).

Forestry.

CONSERVANCY OF OUR FORESTS.—NO. 3.

By THE EDITOR.

With reference to the statistics given in my last article on this subject, published in the Journal for December, 1919, I am now able, by the courtesy of the Director of Forests, to bring these up-to-date, as they appear in his Annual Report for the year 1918. The total area of Timber Reserves in the State on 31st December of that year was 2,671,139 acres, the number of Reserves being 273, including areas proclaimed during that year. There were sixty-nine State Forests, embracing an area of 1,121,900 acres, and 73,980 acres on fourteen National Parks, the revenue amounting to £71,985 1s. 8d., and the expenditure to £21,877. Receipts from forest grazing and miscellaneous receipts are not included in the revenue.

The value of the timber imported into Queensland in 1918 was £1,406,582, and of our exported timber £247,056.

The forest service timber cut in Queensland for the years 1914, 1917, and 1918 is shown as follows:—

	1914.	1917.	1918.
Sleepers and transoms (number of) ..	951,500	226,230	116,723
Piles and girders (lin. feet)	387,550	71,940	101,214
Telegraph poles and house blocks (lin. feet)	236,400	99,520	92,289
Posts, rails, and palings (number of) ..	150,900	82,530	68,267
Fuel (tons)	20,000	50,570	50,921
Sandalwood (tons)	523	454	406
Mining props (lin. feet), &c.	941,000	..	1,305,171

—the mill logs being represented by—soft woods, 38,743,067 sup. ft.; hardwoods, 7,141,934 sup. ft.; and red cedar, 172,373 sup. ft. The combined private and forest service log cut for 1918 amounted to 179,402,000 sup. ft., made up as follows:—Pine, 107,152,000; hardwoods and other timbers, 71,855,000; and cedar, 395,000—of which private temporary services supplied 74.3 per cent. of the raw material required annually for the 221 sawmills of Queensland.

Concerning the work of the Forestry Department on Fraser Island, the undertakings there were mainly along the lines of natural regeneration; and, as stated by the Director of Forests, high success was achieved with the cypress pine, despite the very arid conditions, and in the eucalyptus regeneration areas blackbutt and tallowwood gave a very heavy seed fall. In five years from sowing (26th January, 1914) a photo. of the young trees was taken (May, 1919), and they were found to be 64 ft. in height, with a girth of 21¾ in. The soil on which these trees throve so well was sandy, with some humus, the total rainfall having been 60 in.

In the experimental plantations on cleared scrub sites, seedlings set out in February did well, despite unfavourable weather. For instance:—Robinia, pseudo-acacia, at the end of the first year, was 10 ft. 6 in. in height; red cedar, 8 ft. 6 in.; kauri, 4 ft. 6 in.; hoop pine, 3 ft. 2 in. Spotted gum, an introduced eucalypt, also flourished under island conditions.

There are 273 Forest Reserves, having an area of 2,671,139 acres, and sixty-nine State Forests, and fourteen National Parks in Queensland, with an area of 73,980 acres.

For many years, forestry had very little Government recognition, and even to-day the reservations for forestry purposes only represent eighty-eight hundredths of 1 per cent. of the territorial extent. But the Forestry Department of to-day has fully grasped the position of the timber resources of the State both in the past and present, and is bringing all its energies to bear upon the most important work of conservation, regeneration, and reproduction of our most valued timbers. It recognises the critical position in which Queensland forestry stands, and points out that Mr. D. E. Hutchins, a distinguished forester, who visited Australia in 1914, set down Queensland's forest wants at a permanent reservation of 43,000,000 acres.

We would advise all our readers who are interested in the Forestry and Timber questions in this State to study the very excellent Annual Report of the Director of Forests for the year 1918.

Entomology.

ROOT-BARK CHANNELLER OF CITRUS.

DECILAUS CITRIPERDA, H.T.

COLEOPTERA, Fam. CURCULIONIDÆ, Sub-Fam. CRYPTORHYNCHIDÆ.

By HENRY TRYON, Entomologist.

(Plates I.-III.)

INTRODUCTORY.

The injurious action of this beetle on the orange first came under our notice in December, 1908. It was not, however, until nearly nine years afterwards (July, 1917) that attention to it was recalled and its noteworthy harmfulness was remarked. The late S. C. Voller, Instructor in Fruit Culture, noticed then in an orangery at Montville, Blackall Ranges, that certain trees exhibited a lack of vigour, suggestive of "Die Back," but without the shedding of foliage, and on examining their root-system he found that those roots at or near the surface were apparently either dead or nearly so, and, moreover, showed evidence of having been formerly attacked by small boring-insects. In some of the smaller roots, indeed, that were still green and fresh, he found "grubs" or beetle-larvæ.

This discovery was in an orangery then owned by J. Snowdowne. Immediately afterwards Voller met with a second occurrence at Mapleton, and concluded that the trouble was already assuming serious proportions.

Later, in September, 1918, J. Mitchell, successor to Voller, also remarked the decadence of citrus trees at Montville; and found, too, that the roots of affected trees had failed, but—as he first considered—as the outcome of fungus-attack—?Armillaria.

In both instances illustrative specimens had been communicated by the Director of Fruit Culture, A. H. Benson, to this office, and thus had the insect origin of the trouble been confirmed. It being remarked by us, with regard to the latter, that "The suggestion that it is a case of the action of Armillaria, or of any other fungus, finds no support in the features presented."

The Instructor in Fruit Culture, continuing his observations, and in forwarding specimens, including examples of the beetle, reported on the condition of citrus trees that had yielded them (9th September, 1918):—"Many trees two-thirds dead; some completely gone. Root-borer and fungus very bad. Most of the main roots are dead and decaying in the soil, and there is nothing to support the tree."

On learning these facts, the Director of Fruit Culture, A. H. Benson, devised a field experiment, aiming at the subjugation of the "pest," associating with him for the purpose a Montville Fruit Growers' Experiment Plot Committee, comprising four orchardists. These investigations referred to were initiated on 2nd October, 1918, the area chosen for the work being in the orchard of Mr. G. J. Butt, a member of the committee.

This field experiment was conducted by J. Mitchell, acting under instructions of the officer in question.

On 6th September, 1919, at a conference of thirty local citrus-growers, held at Montville, it was resolved, as no practical results bearing on methods for controlling this insect had been communicated to the local association of fruitgrowers, to ask the Minister for Agriculture and Stock to send H. Tryon, Entomologist, to inquire into the trouble. The necessary local inquiry was accordingly made on 14th to 21st October, 1919.

SYMPTOMS OF THE INSECT ATTACK.

It does not appear that citrus trees with which the Root-bark Gauger is associated manifest any very characteristic features, so far as relates to their vegetative growth. They fail step by step, as do trees that are being gradually deprived of their root-system; this failure being especially emphasised by the occurrence of conditions—drying out of soil, &c.—that are generally inimical to growth. At the same time, trees may be seen in which injury to the root-system has occurred, and, further, that yield examples of the insect on inspection, and that, notwithstanding, do not manifest any indication of general ill-health whatsoever. This is, of course, a significant fact.

Of four mandarin orange trees, each of the same age (about 10 to 12 years), growing together, the only one attacked had an impoverished look, a reduced leafage, and quite a deal of die-back.

On examining the base of the stem, say, to 6 in., more or less, from the soil-surface, the earliest symptom of attack will reveal itself. Here the bark, instead of being smooth, will exhibit numerous gauged-out wounds, often partly filled with earth particles, and with roughened, raised margins. These take the form of channels, of a short irregularly serpentine course, often adjacent one to another. Usually this injury will appear to have been of old standing, and in process of being overcome, if not obliterated, by bark-growth. On uncovering roots, from the stem-base outwards, more or less injury of the same character will be found corresponding in great measure to the time the damage has been in progress.

Roots may manifest it along a course of several feet, both the main ones and their branches being affected. These roots may be ones of the largest girth or ones less than ¼ in. in diameter.

In a root that has been severely attacked, the entire surface will be occupied by conspicuous meandering channels with roughened margins, each measuring 2 in. or 3 in. in length. These may be more or less occupied or filled with callus that has grown inwards from their edges, as well as with earth. When the attack has been less pronounced these channels in the bark will, of course, be more or less isolate.

There will, however, be commonly more injury than at first meets the eye: since when the channels are first made by the "grubs" or beetle larvæ, and for some time afterwards, they are not only filled with the triturated inner bark, but also covered over and concealed by the outermost layer of this. In this case only a very fine fissure, following the line of each insect's tunnelling, will mark its presence; and this only can be detected on close observation. Therefore, the full extent of injury can only be discerned on scraping off the bark-surface. This, of course, only applies to injury that is not of long standing; for the bark above each insect's working, having already died, sooner or later falls away, and so exposes the damage beneath.

One will be surprised often to find that, although the insects' workings are so conspicuous, much of the bark of the root occupied by the insects is still alive. This is because the grubs always keep their channels distinct; they are not commonly directed so as to produce a ring-barking effect; and, being gnawn slowly through the living under bark (cortex), this will constantly develop wound-tissue, to overcome the direct injury occasioned. (*Vide* "Habits of Insect," p. 76.)

When, in the case of any root, the attack has been made by numbers of insects, and pursued by successive generations of these, and when circumstances occur to prevent natural root-growth, total destruction may be brought about, although it is seldom, if ever, that every root of a tree succumbs. In fact, natural occurrences tend rather to assist the tree to meet insect-attack, or to recover from it, than to "go under."

CITRUS SPECIES AND THE INSECT ATTACK.

All varieties of citrus producing ordinary oranges, as well as those of the mandarin type, are favoured by the beetle. The lemon is also attacked in some instances. [Trees on non-lemon stocks, however, afforded the instances referred to.]

However, not a single instance of Seville orange-tree showing injury was observed; even, when its root-system was explored with a view to its discovery if present—a remark that applied to some of the oldest Seville orange trees noticed, ones aged 27 to 30 years, grown by G. Butt, senr., and W. H. Harvey.*

Obviously these remarks apply, in the case of citrus trees raised by grafting (and commonly "worked trees" are grown in the Blackall Mountain district), to the citrus variety or species forming the stock, since attack is confined with this insect to parts occurring beneath the soil-surface.

As far as could be ascertained, the ordinary sweet orange is the stock on which the round oranges and the lemon are grown, whilst the Scarlet or Emperor Mandarin is grown on its own stock, and the Beauty of Glen Retreat Mandarin on the latter and on its own stock as well.

Our observations tended to show unmistakeably that grafted or worked trees experienced the ill-effects from the attacks of the beetle to a much greater extent than did seedling trees. In fact, no seedling citrus of the round orange type was observed that had been injured by the insect.

Further, that of all kinds of citrus found to be attacked the mandarins were the ones in which noteworthy damage was most remarked.

This incidence of attack had evidently in all cases a more or less direct connection with constitutional vigour, with, too, the manner of root-development—factors

* In the case of a single Seville orange tree (Orangery—G. Vining), aged about 18 years, nine root-gauging beetles were found in the soil at the base of the trunk, but no bark injury to the stock, even to a depth of 5 in. to 6 in., had been inflicted. It was not ascertainable whether this Seville was a seedling or worked tree.

however, that might be linked. Thus, deep rooting trees as ordinarily understood escaped attack or injury, shallow-rooting ones the reverse. [This relation between tree and injury is intelligible on considering the habits of the insect and the behaviour of the tree under attack. (*Vide* p. 79.)]

Citrus Tree: Age and Insect Attack.

In places where the Root-gauging Beetle is prevalent, it is evidently quite exceptional to find young citrus trees, even of kinds especially liable to attack by it, exhibiting injury by it either above or below ground.

This remark applies not only to young trees growing within a few feet of one whose roots are severely injured, and in which the insect is still present, but to trees even that have been planted in substitution of ones that have had to be removed owing to the damage from beetle-attack and its consequences that they have experienced.

At the same time beetles may often be found in exploring the soil at the bases of their trunks, especially should the surrounding earth have dried out, and the former be still somewhat damp.

A special instance of this was remarked in connection with the affected trees that were growing in the site of the experiment plot in G. J. Butt's orangery. Here five trees of the Valencia late variety had been planted about six years since between old affected ones. Of three of these two yielded examples of the beetle, but no trace of injury.

In other places young citrus trees growing continuously with affected ones on the same land were perfectly "clean." And, as a matter of fact, no young citrus tree that could be said to be injured at all by the insect was met with in the course of the inquiry.

At the same time, the older trees may have their roots still sound and healthy, or, if not sound, then without much evidence of insect attack. [*Note.*—No old tree was wholly extirpated by us, and thus its entire root-system brought under observation.] This was shown on examination of several of those planted originally (about 30 years since) by Messrs. Mills, Dalton, Whitemeyer, G. Butt, senr., and W. H. Harvey. Apparently, however, the majority of the older citrus trees now growing in the Montville-Mapleton area are seedling trees.

Native Citrus Trees and Insect Attack.

Examples of the Finger Lime were found growing in the scrub lands not as yet brought under cultivation. However, the root-systems of examples of those on examination gave negative results as regards the presence of the insects. The subjects of this inquiry were, however, quite few in number and young plants only. [*Note.*—The insect was not more prevalent in citrus trees growing adjacent to scrub than elsewhere.]

Citrus Tree: Factors Contributory to the Insect Attack.

Citrus trees that experience most damage, as well apparently as ones in whose root-systems the insects principally congregate, are those in which natural decadence—reached in some species or varieties of citrus sooner than in others, and in worked trees earlier than in seedling ones—has commenced, or has been precipitated on its onset and accelerated in its progress by uncongenial soil conditions, defective or faulty horticultural treatment (neglect), soil depletion, and adverse seasons—latterly so noteworthy, rendering the superficial soil unsuitable generally for plant-growth.

At the same time, these factors, or some of them, have operated in the Blackall Mountain area to destroy citrus trees, or nearly to do this, especially in the case of "neglected orchards," without any co-operation of this root-channelling beetle whatsoever.

These contributing circumstances to citrus tree injury in the presence of this root-channelling beetle not only explains the fact that the noticeable injury attributable to it falls far short in its local extension of what its wide occurrence would suggest might be experienced, but at the same time indicates a line of action that, if pursued, would greatly reduce damage such as is now being perpetrated. Fortunately for the citrus grower the orange, generally speaking, is a tree that it is very difficult to kill, where its destruction is not directly aimed at, but involved in injudicious treatment or default of action of any kind.

The Insect and its Description.

The Beetle.—This is a dull black elliptic-oblong strongly convex weevil, having a reddish clay coloured patch of scales at the base of the wing covers and on the sides below. It is from 6½ mm. to 7½ mm. in length [*Note.*—1 mm. or millimetre is about $\frac{1}{25}$ in.] measuring from the front of the head to the tip of the wing covers (elytra),


1
2
3
4
5
6

PLATE 3.— CITRUS ROOT-CHANNELLING BEETLE—*Decilaus citriperda*, n. sp.

Fig. 1. The Beetle—Dormant. Nat. size.

Fig. 2. The Beetle—Active. Dorsal view. Magnified.

Fig. 3. The Beetle—Lateral view. Magnified.

Fig. 4. The Beetle—Dorsal view; wings expanded, 2nd pair pad-like. Magnified.

Fig. 5. The Beetle Larva—Magnified.

Fig. 6. The Beetle Pupa—Magnified.

(*Nos. 2 to 6 from Drawings by H. Jarvis.*)

and rather less than half this in breadth. It has the prothorax and elytra, or two main portions of the body, very distinctly separated or defined, the latter being the broader. This, too, is just twice the length of the prothorax. Both portions are occupied above with very distinct puncturation, the punctures on the wing-covers being in lines, whilst those on the forebody uniformly cover its surface. Its true wings are reduced to mere pads. The beak or rostrum is stout and curved, and, lying in a channel, passes beneath the body. Examples as appearing when photographed are represented on Plate 3., fig. 1.

It does not appear that it is one of the Australian weevils previously made known in entomological literature; much less has it been referred to amongst citrus-injuring insects. It is therefore necessary to append the following technical description of it, that it may be recognised amongst other beetles in the group to which it belongs—*i.e.*, Sub-family, *Cryptorhynchidæ;* Family, *Curculionidæ*:—

TECHNICAL.—*Decilaus citriperda*, n.sp.* Dull black; head beneath brown; antennæ scape and 4 tarsal joints reddish. Elytral surface, prothorax, upper surface of the rostrum, outer surfaces of the femora and tibiæ with appressed linear pale clay-coloured narrow scales; sparsely occurring except on legs; those on the prothorax arising from large punctures; those on the anterior prothoracic border curved upwards; those on the flat faces of the tibiæ in 3 rows. On sides of rostrum in front of scrobes, on joints of funicle, before terminal hook of tibiæ, and forming a dense circular patch near their ends on outer side, non-appressed brown hairs, or hair-like scales. At the base of the elytra laterally, on the outer face of anterior coxa, and on the sides of metasternum larger oblong appressed reddish clay-coloured scales forming in each case a dense patch. In each abdominal puncture an appressed broad scale smaller than those of the upper surface. Pectoral canal glabrous.

Head immersed in prothorax; vertex smooth, finely and remotely punctured; front closely and coarsely punctured; numerous transverse striæ on nitid surface beneath. Eyes hidden by ocular lobes of prothorax, widely separate, with a narrow smooth orbital ridge, ovate narrowed inferiorly, coarsely facetted. Ocular-foveæ shallow contracting base of rostrum. Rostrum broad flattened slightly widening distally, arched, extending to hind-borders of anterior coxæ, coarsely foveated on upper surface; scrobe having a prominent edge above, wide, directed obliquely beneath the rostrum to lower border of eyes. Antennæ arising at about one-third of its length from end of rostrum; scape not reaching beyond end of rostrum; funicle with 1st and 2nd joints subequal-longer, succeeding joints smaller subequal gradually widening; club oval 1st joint equal to 2nd and 3rd. Prothorax convex rounded at sides, slightly constricted before fore-border; fore-border about seven-tenths length of hind-border prominent and over arching head, its ocular lobes rounded concealing the eyes their cilia short pale-brown; lateral borders angularly extending downwards behind in apposition to anterior coxæ; hind-border bisinuate, prominent in centre, shallowly concave laterally; surface completely occupied with large circular foveæ (thimble punctured) with little if any trace of median line, the punctures at base of ocular lobes in a linear series of about 8-smaller. Scutellum wanting. Elytra convex slightly exceeding 1½ times prothorax in length, slightly wider than it and excavated in front; sides lowly descending; convexly declivous from about ½ length, narrowed and somewhat constricted towards apex that is rounded and tumid; nine longitudinal rows of deep foveæ each with a central granule-like body, a shorter similar row of 5 foveæ only behind shoulder, the foveæ oblong in outline, slightly smaller on disc

* The present insect was formerly provisionally assigned by the writer to the allied cryptorhynchid genus *Poropterus*. (Report Entomologist, Department of Agriculture, Queensland, 1918-19.) It has been transferred to *Decilaus*, Pascoe (Trans. Ent. Soc. Lond., 1870, p. 205), as interpreted by A. A. Lea ("Revision of the Australian Curculionidæ belonging to the sub-family Cryptorhynchides." Proc. Lin. Soc. N.S.W., 1898, Pt. 2, July, 1918, pp. 190-192.) It is evidently distinct from any of the species of *Decilaus* described or dealt with by Lea in this memoir. Again, it is not one of the beetles described by him subsequently under this generic name in a paper read before the Royal Society of South Australia (*vid.* Trans. Roy. Soc. S.A., XXIX., pp. 230-6, 1906.)

and becoming greatly reduced in size on hind declivity, where obscure punctiferous striæ replace them; the interstices about equal in breadth to the foveæ are plane (slightly convex on hind declivity) and occupied with punctures of two sizes, the larger ones setigerous and tending to form interstitial lines. Under surface: Pectoral canal, a wide channel deepening behind extending to mesothorax bounded by projecting lateral borders of prothorax and by coxæ of front legs; mesosternal receptacle bounding channel behind in form of a perpendicular narrow plate slightly concave on its upper edge and in front; base of mesosternum rising quickly with a sharp ridge from posterior border and expanding into receptacle [as in genus *Elwana*]; metasternum as long as 1st abdominal segment and widely excavated behind to receive its process, narrowly projecting in front between middle coxæ, sides coarsely foveate; metasternal episternum narrowed anteriorly; abdomen with discrete large foveæ, 1st segment with its median anterior projection broad and rounded, without lateral channels, segmental sutures complete and well defined, 1st and 2nd segments (less projection of 1st) subequal, longer than each of 3rd and 4th, these equal, 5th segment equals 3rd and 4th together. Femora short coarsely net-punctured externally, stout, bent, non-dentate, each with a groove on inner surface in which tibia is received in repose, hind femora not extending beyond 4th abdominal segment. Tibiæ short, compressed, upper edge narrow, 2 low ribs separating 3 rows of setiferous punctures on each plane surface, hind tibia with an angular projection on upper border near base beyond which this is shallowly concave, each tibia with a sharp curved strong claw-like tooth at extremity below preceded by a brush of hair. Tarsi, 3rd joint broader than others with rounded well-separated lobes, joints 1 to 3 with hair pads beneath, claw-joint narrow glabrous, claws divergent. Length, 6 mm. Individual range of length from 6.5 to 7.5 mm.

Hab.: Blackall Range and Buderim Mountain, S. Queensland.

Larva (*"Grub"*).—This when full grown is larger than the dimensions of the beetle would suggest. It is of a very pale-yellowish colour, and unclothed. It is of nearly even breadth, though rather widened in front, and measures about five times as long as broad. The seven body-segments behind the head are well defined, especially at the sides; those comprising the terminal third of the body less so. Broad corrugations marked out by furrows also cross the body. On each side beneath are two rows of low rounded prominences each bearing two scarcely discernible hairs that serve the purpose of feet. Posteriorly the body ends with suddenness roundly in a little protuberance, bearing a row of six or eight weak hairs. The round anal orifice is beneath this. In front the body suddenly narrows to half its width and overhangs slightly the head. This measures 2 mm. across and is somewhat longer. It has parallel sides. It is of a horny brown colour, with the fore-border of the front the cheeks and jaws very dark castaneous brown. The labrum or upper lip is rounded in front and ends in a short brush of glistening hair. It has two little depressions behind its fore-border, each giving rise to a single hair also. The mandibles are stout and prominent, with even concave gauge-like cutting edges. The submentum is large, almost circular, with a triangular indent in front for the mentum. The maxillæ are stout and conspicuous on each side. The maxillary and labial palps are two-jointed; the basal joint in each being similarly stout. Length, 15 mm. by 3 mm.

Pupa (*"Chrysalis"*).—This, as is usual in beetles, foreshadows in appearance the beetle or perfect insect. It is elongate-oval in general outline rather longer than twice its width. The thorax and abdomen are equal in length. The prothorax is shaped as in the beetle; its fore-border is marked by a row of four prominent dark coloured projections, each usually bearing a stout bristle; a row of similar but weaker ones cross the middle; and two in line are behind the outer of these on each side. Both meso and meta notum—the latter rectangular—widely separate the wings and wing-covers, each having a transverse row of four short bristles. The wing and wing-covers extend backwards to the fourth abdominal segment and slope downwards and outwards. They are sub-equal, or the wings are the longer. [*Note.*—In the beetles they have undergone no extension and increase in size, whilst the wing-covers have largely developed.] The abdomen narrows convexly to its extremity. Its nine segments are well defined, especially above. Five black circular spiracles occur. Between the lines in which the spiracles are placed along the hind borders of each abdominal segment above is a row of very short stout black spines. The terminal segment of the abdomen ends in two prominent stout spines, each directed inwards. Beneath the pupa exhibits the organs folded as in the adult beetle: Four very short bristles occur on the head in front, about twelve on the upper surface of the backwardly directed proboscis or rostrum. Length, 8 mm. by 3.5 mm.

THE INSECT: ITS HABITS.

The Larva.—The beetle when about to oviposit gnaws a small depression or hole (.5 mm. in diameter) in the bark at a spot where living tissue occurs beneath it, and lays its oval shaped egg therein—one egg in each. The small larva, on hatching out

from this, at once commences to mine, but apparently in no fixed direction, upwards or downwards, the channel so formed increasing in width from 1 mm. (½ line) to 6 mm. (3 lines). A single larva may mine to a length of 2 in. or more, but the length of stem in which this takes place is much less, since the course pursued is generally waved or serpentine, the insect turning aside in meeting any obstacle such as the origin of a secondary root or other beetle-larva's working, although in the case of the latter it will often proceed alongside of it for some distance without, however, the channels of the respective insects ever merging. The channel mined, again often turns on itself under the circumstances mentioned—thus, after proceeding forward along the roots, turning towards its extremity. Further, it is not circular in section, its width being at least three times its height. It is confined to the cortex or bark of the root, extends to its full depth, being carried along the surface of the wood that is bored. Outwardly it is covered by the outermost thin layer of root-bark, and thus is at first only brought to light on removing this; although, as this bark, to the extent undermined, soon dies and fissures, an irregular longitudinal cleft following the course of the insects working will discover its presence. The beetle larva always lives in the forefront of its mine, in a small empty cavity whose floor is the outer surface of the wood, and whose walls are the living bark tissue it has just excavated. This scarcely exceeds its dimensions in size. Behind the insect the channel is filled continuously with chewed-up tissue, this matter being composed principally of short lengths of woody fibre (liber) and not of fœcal particles (frass). It is too well compacted together, not falling away when exposed. It is noteworthy, again, that the direction pursued by the beetle larva in burrowing is seldom directly transverse to the root, and much less frequently, if ever, does a single insect girdle it. This remark especially applies to the larger of the roots in whose bark it operates. In a smaller root measuring only 10 mm. in diameter a channel, after proceeding forwards and then curving partly across, wound around till it had passed its starting point, the egg-cavity, but then this was 5 mm. above, and thus was continuity of the living bark secured. This was the nearest approach in ring-barking effected by one of seven beetle larvæ—representing two generations—that were or had been operating in a root length of but 10 cm. This is one significant fact in the explanation of the relatively small injury experienced through root infestation on the part of the insect. Others will be alluded to. (*Vide* "Plant recuperation under injury," p. 79.)

The Pupa.—When the beetle larva is full grown, and has reached the proper stage of growth, it widens its workings suddenly from a channel of 6 mm. in width to a chamber—still within the root-bark tissue—16 mm. or more across. This for the most part is filled up, as is the channel; but now it gnaws downwards into the wood, forming a shallow horizontal oval cavity therein. With the woody fibre it thus removes, bent and compacted around, it now walls in this cavity so as to form a pupal-chamber, whose floor is the bare wood, and that is covered above by the root-bark. This cavity measures from 8 to 9 mm. in length and is 5 mm. across. Within the pupal cavity the insect now transforms, developing into a pupa, as described (*vide* p. 76.) The pupa in turn changes whilst still within this cell to the perfect insect or beetle. This, however, does not immediately issue forth. It is at first a pale-brown colour, but it soon darkens with age. When the time has arrived for this act, the beetle makes an irregular hole through the bark that has covered the chamber in which it has arisen, and so effects its exit.

The individual beetles are long-lived. There are grounds for concluding they are at least two-brooded, adults coming forth in the spring (September) and again in December-January, but this longevity referred to causes the adult insect to be discoverable during a greater portion of the year.

The insect is nocturnal in its habits, hiding in the soil during the day. When it comes forth after nightfall it crawls slowly over the surface. The circumstances under which it comes into being or generally is met with, the fact that its body is almost invariably soiled with earth particles, and its special structure, together render it certain that it possesses some faculty for digging its way through the soil, either upwards or downwards, although usually availing itself of fissures and clefts therein for its more concealed movements.

It is commonly to be encountered during the day in the soil immediately around the base or collar of the orange-tree trunk, especially should the soil here be slightly moist, although somewhat free and open. Here it may occur at a depth of between 2 in. and 6 in., possibly below this. Usually evidence of old injury by root-channelling beetles on the bark of this part of the orange tree is found where the insects are encountered, but not always so. The beetle may commonly be found within the limits of its haunts, under stones and logs lying on the surface somewhat embedded in the soil.

Usually when first seen it is simulating death, with its snout tucked up well under its body in a special groove for its accommodation and its limbs folded.

In addition to the situations mentioned, the insect is to be met with along the courses of the roots radiating outwards from the trunk-base of citrus trees, and associated now with definite injury. It does not, however, favour those roots that occur at greater depths than a few inches from the soil-surface.

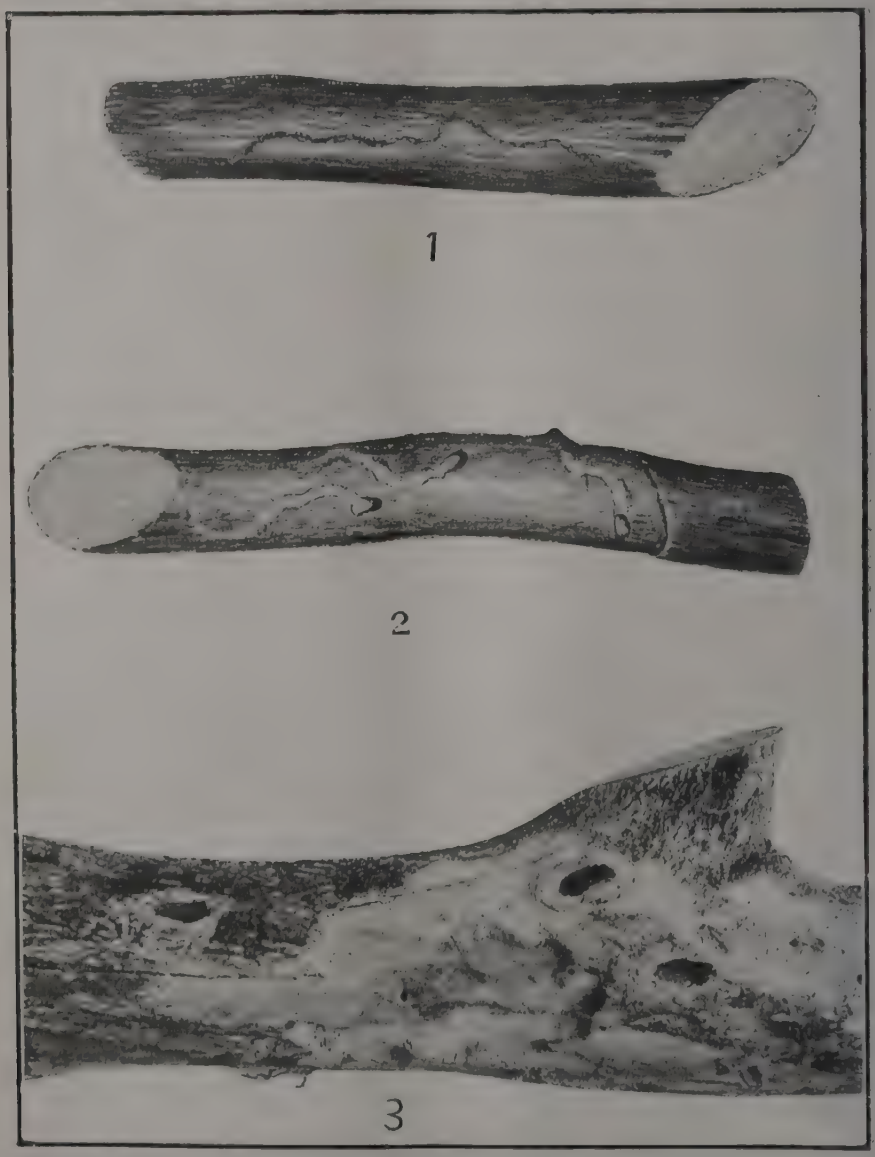


PLATE 4.—CITRUS ROOT-CHANNELLING BEETLE—*Decilaus citriperda*, n. sp.

Fig. 1. Beetle Larva injury—Linear crack in bark following course of larva channel. Nat. size. (*Drawing by H. Jarvis.*)

Fig. 2. Beetle Larva injury—Channels (burrows) produced by young beetle larva. (*Note.*—Exposed on removal of bark surface.) Nat. size. (*The same.*)

Fig. 3. Beetle Larva injury—Channels produced by full-grown larvæ and showing three empty cocoon chambers. Nat. size.

(*From Photograph by Mr. W. J. Sanderson.*)

Issuing from the pupa chambers, already described as constructed in the wood and bark at the surface of the roots—several, it may be, from spots on the same one not far apart (*vide* Plate 4, fig. 3)—the early life of the newly-arisen beetle is at present somewhat a matter of conjecture. Insomuch as successive generations of beetle-larvæ arise from eggs lain at intervals on the same area of root-bark, or in different ones adjacent to one another in one length of root, one may infer that, rather than proceed to the soil-surface, they pair, and when female insects return to the roots through the soil again, mating taking place on issuing from the pupa chambers, and so the beetle works its way along the root surface to a fresh and convenient spot where its eggs may be placed singly, as we have seen, in the bark. How many of these eggs each female insect lays is as yet unascertained, but probably less than twenty. We have found in small areas of bark young larvæ of the same age, and occupying channels of identical size and length (*vide* Plate 4, fig. 2), to the number of but six, and nine in instances, evidently the outcome of separate acts of oviposition by two beetles. Where old larval channels whose bark roofs have fallen away, and are not fully filled in by wound-tissue, occur, the passage of the beetles along the roots is easily effected; whilst again, with the contraction of the soil, on the rising of its temperature or the reduction of its moisture content, arise openings adjacent to the root surfaces that again may be availed of for this purpose. The fact that, especially in the case of a larger root, the larval mines or channellings may at times be almost confined to one side of these organs, usually the lower side, may be accounted for by the presence of such by-ways.

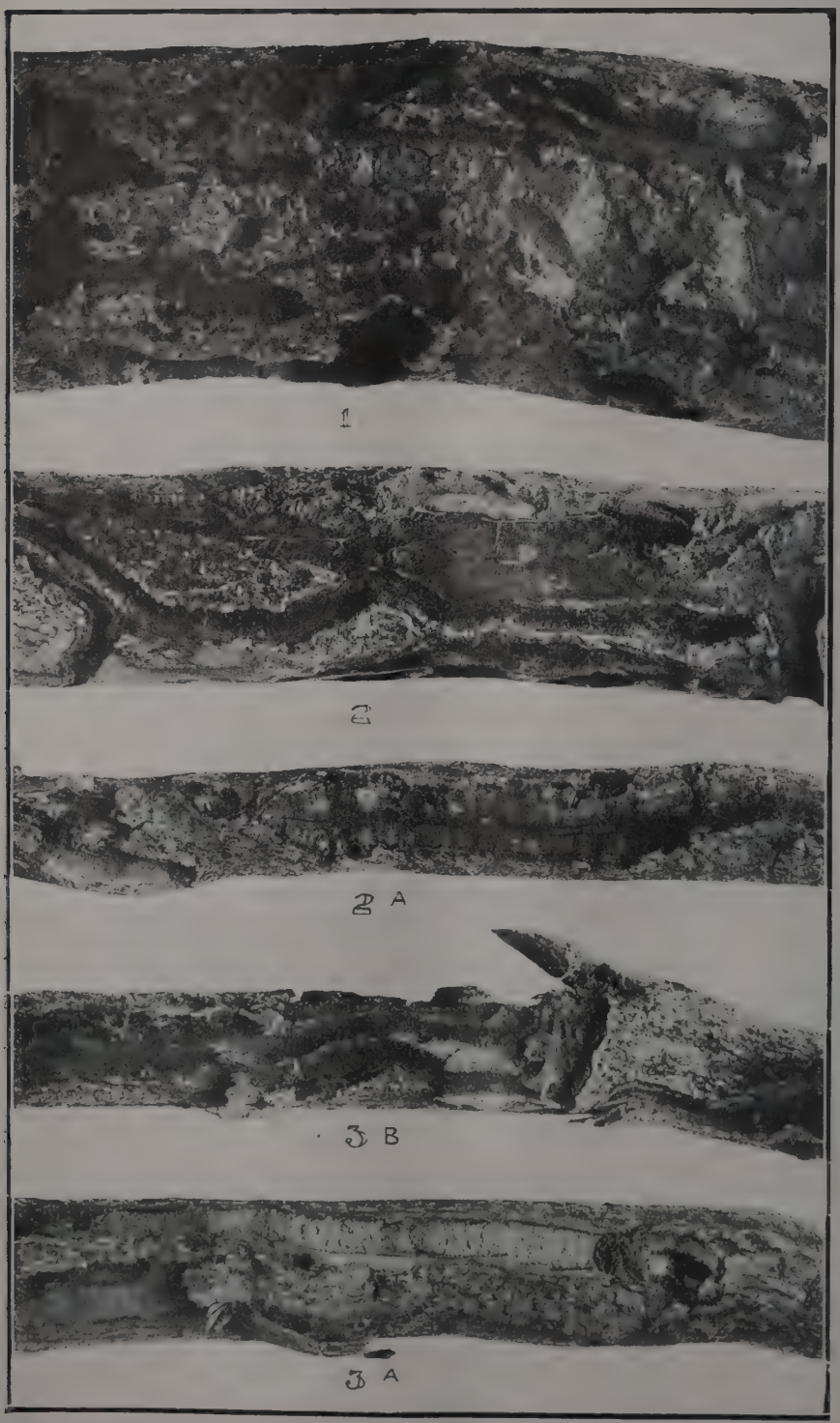
As we have seen, the beetles have no functional wings, these organs being represented by small pads, and that, therefore, they do not fly but crawl only. This and the facts above arrived at explain the concentration of the beetle attack on isolated trees in an orangery, and their long association with these trees, grown as they are isolatedly. It also explains the fact that beetle attack is confined to limited areas, and is very slow in becoming distributed. Thus, in an instance of its pronounced local development, and where trees obviously attacked could be counted by the score—a spot where this root-channelling beetle must, in fact, have been present for years—special investigation proved that an ordinary road only served to separate clean and beetle-ridden areas, only a single tree being found to harbour but a few of the beetles in the former.

It may be affirmed that the beetle is a denizen of the local scrub, and is associated with the roots of one or more kind of the trees composing its flora. The growth of these continuously in an area would explain the general distribution of the insects therein, as opposed to their segregation in the root-system of isolatedly growing trees as we find in the orangery. Thus, in their native haunts, they might at first elude detection, as has been the experience in this inquiry.

The food of the beetle has not been ascertained, but the well-developed mandibles which are comprised in the mouth organs that terminate its rostrum or snout are, as we have seen, well adapted for gnawing into bark-tissues. The grub itself—whose mining operations are confined to the living bark or cortex of the citrus tree roots, and whose life and growth takes place invariably therein—we may infer, feeds on the plant tissue that this yields. The inference, however, is not wholly warranted. The floor and walls of the chamber at the head of the channel it has gnawn, and in which it resides, produce constantly little droplets of gum that reddens as it dries, and it fills its chambers not with the by-products of digestion, but with triturated fibre principally. We know little of the feeding habits of that section of the weevil family of beetles—the *Cryptorhynchidæ*—to which this citrus root channelling species belongs; but it is an ascertained fact that certain wood boring beetles of another family—the *Scolytidæ*—do not feed upon the substance of the tissue that contains their tunnellings.

The Citrus Tree under Beetle Attack: Its Reaction.

In addition to the special gum-exudation above alluded to, the roots of the citrus trees under ordinary circumstances of growth react, on being gnawn into by the beetle-larvæ, in a manner that tends, often successfully, to secure them against final destruction. Under conditions of ordinary vigour, the living bark beneath the root-surface or channel inhabited by the beetle larvæ being commenced, and continuously thenceforth, functions in a way to overcome injury. On the sides of the channel, and on its base to a less extent, issues, from the active cambium and other elements of the cortical tissue, a gelatinous substance that is of an orange colour, and hardens on exposure. (This is readily seen on uncovering the recently made channel.) This lining the channel or tunnel not only evidently prevents the entrance of tissue-destroying fungi, &c., but, itself becoming organised, forms plant-tissue also, serving in the end to replace that that has been broken down by the beetle-larva in its working. In fact, it is the commencement of the formation of wound-tissue or callus that, under favouring circumstances of the orange tree's growth, will gradually close the channel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2
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PLATE 5.—CITRUS ROOT-CHANNELLING BEETLE—*Decilaus citriperda*, n. sp.

Fig. 1. Beetle Larva injury—Large root, showing much damage. Nat. size.

Fig. 2. Beetle Larva injury—Natural recovery on being injured by growth of wound-tissue or callus. (*a*) Channels partly filled up. (*b*) Entirely occupied.

Figs. 3*a* and 3*b*. Beetle Larva injury—Injury not overcome. No wound-tissue formed (*a*) Single channel. (*b*) Contiguous channels or burrows.

(*From Photographs by W. J. Sanderson.*)

as it has been made, or if it leave the channel open to a slight extent the floor of this, drying out superficially, will itself serve to protect the living wood beneath from further destructive change.

When this happens, the citrus experiences little or no permanent injury, and it can withstand much ordinary mechanical damage, especially when, as in the case of this beetle larva's attack, girdling of the root ("ring-barking") is rarely effected, even when no wound tissue or callus is produced, as sometimes occurs.

On examining the characteristic injuries exhibited by citrus tree roots that have been injured by this beetle-larva, one will observe the insect's channellings in the bark occupied with the wound-tissue in all stages of completeness. (*Vide* Plate 5, figs. 2 *a* and 2 *b*.) This is especially so, since the callus lining, on growing inwards and upwards along the insect's tunnel walls, pushes off the thin layer of outer bark that has covered them over above. It also results in the old workings being marked out by ridges on the bark's surface that take years of root-growth to obliterate. (*Vide* Plate 5, fig. 1.)

Under certain circumstances this wound-tissue or callus does not develop, and then fatal injury to the root may result:—(1) When two beetle-larvæ channels or more lie alongside one another, sufficient breadth of intervening tissue may not have been left, so that instead of developing callus it will dry out and die. Thus, considerable areas of exposed wood may result that are incompatible with healthiness. (2) When the usual seasonal rains fail, and the soil dries, the roots of the attacked citrus trees lose their turgour and vigour owing to their not being able to secure water to replace that lost in transpiration of the foliage. Then no new tissue is produced, and this callus lining the beetle-larvæ's tunnellings is absent. The wound inflicted in the living bark therefore remains open, and ill-effects on the root-system and tree's health generally are experienced to the fullest extent that can follow beetle-larvæ attack. This failure in wound-tissue production is shown on Plate 5, figs. 3 *a* and 3 *b*.

The reaction of the root's cortical tissue to the insect's tissue-destructive operations above detailed differs in degree amongst the several kinds of citrus—a fact that may explain the different extent to which they severally suffer when subject to them.

But it especially accounts for unusual destructiveness under local climatic conditions, characterised by a failure in the seasonal rainfall, such as had been experienced for months past, when the present inquiry was instituted.

REMEDIES.

Experiments so far conducted, valuable as they have been, have not discovered a mode of treatment that can be relied upon for successful results

The earliest treatment resorted to appears to have been the use of salt applied to the soil immediately around the base of the tree trunk, and which, it would appear, was originally suggested by the late S. C. Voller, Instructor in Fruit Culture. The salt derived from meat-packing houses has been generally that employed. J. Snowdowne, who applied this remedy extensively, treated, as he testified to us, forty trees on a single occasion. He employed in this work, too, also sulphur and salt together, combining them in equal proportions, and using half a kerosene tin full (2 gallons) to each tree. He, however, did not get results that were satisfactory to him (but probably better would have been obtained had this treatment been practicable when the trees had not already exhibited the injury that they then had already experienced —H.T.)

Similarly, the experiments inaugurated by the Director of Fruit Culture, A. H. Benson, as already alluded to, and that varied considerably in detail, have been inconclusive from our point of view as regards indicating the line of direct attack to be followed. These experiments, however, were most useful in one respect, in demonstrating that by the adoption of the proper treatment of citrus trees, as dictated by up-to-date horticultural knowledge, even severely injured trees could be greatly improved in condition. The earlier of those experiments consisted in the use of fungicides (iron sulphate, corrosive sublimate, &c.), and not dictated by entomological science, and an appreciation of the factors determining the injuries, could scarcely be expected to yield successful results. The judicious use of fertilisers and tree-pruning effected, however, the amelioration referred to.

Further experiments are needed, however, as a guide to the best procedure. Only suggestions, therefore, can now be offered as to the lines that these should follow:—

(1) The insects evidently gain access to the roots at the base of the tree-trunk or collar. It would appear then that they might be prevented from gaining this access by placing in the soil here some repellant substance—*e.g.*, one containing crude naphthalene, such as "Vaporite-Strawson," "Fumas," or "Apterite," or the spent lime from acetylene gas production, or some other strongly odorous body.

(2) When already occurring in the orange tree roots themselves, the insects might be assailed by some powerful insecticide that acts in the form of a vapour. Unfortunately, a solution of potassium or sodium cyanide (Mamella process) is not available. Although so destructive to other beetles, the present insect, being most resistant to hydrocyanic acid vapour, is little affected by it. Probably, however, it will be found to be destructive to the beetle-larvæ, even when occurring in their channels in the bark. The same remark applies to bisulphide of carbon, although for other reasons. It is, however, considered that the new insect fumigant (Para-chloro-benzine), that has been found to succeed where other fumigants have failed in destroying root-frequenting insects, will be the best of these forms of insecticides to employ. A supply of this should be shortly obtainable in Brisbane, where samples only so far have been available for use in insect-destruction.

(3) Owing to the fact that the bark-damaging beetle-larva is accessible in its "burrow" when the soil is dry, owing to the fissuring of the bark that covers it, it may be possible to reach it even with some fluid contact insecticide not itself a plant-tissue destroyer. Kyanit, which contains a proportion of common salt, if obtainable, might be used as one of these. Under some circumstances it acts as an insecticide, and may be employed in this connection, especially since it is a promoter of root-growth—a desirable feature in any remedial treatment.

(4) It has been already shown that the citrus tree roots suffer only under the beetle-larva attack, or principally so when they have ceased to grow or exhibit their normal vigour and internal functional activity. Accordingly, the judicious use of stimulating fertilisers, irrigation, and correct soil treatment generally is indicated as a remedy not only preventive of insect attack to some extent, but of the injury to the tree that results from this.

(5) Any treatment that tends to overcome the ill-effects on the root-system of drought during the summer months, or when the growing period occurs, will prove beneficial or sufficient.

ACKNOWLEDGMENTS.

Our indebtedness must be confessed to the Director of Fruit Culture, Mr. A. H. Benson, and the Instructor in Horticulture, Mr. J. Mitchell, for assistance in the field, and for obtaining material for examination. Also to the several citrus-growers of the Blackall Range for facilities in conducting the inquiry.

CANE GRUB INVESTIGATION.

The General Superintendent of the Bureau of Sugar Experiment Stations has received the following report upon Cane Grub Investigations from Dr. Illingworth:—

Everything here is practically at a standstill, since we are in the midst of the worst drought of my experience. From all that I can learn, it equals that of 1915. The cane is suffering in most places, especially the plant, which is very yellow and shrivelled. I have had to forego an extensive line of planting experiments, which I had planned for Greenhills, to test out thoroughly the value of poisons for the control of grubs.

Of course no insects are in evidence, so "it's an ill wind that blows nobody good"; probably many of the beetles will not be able to emerge. Digging to a depth of 3 ft. in the infested fields at Greenhills disclosed that they are badly rubbed, which indicates that they have been waiting to escape for months; indeed, I found some already changed to beetles in the pupation cells when digging last June. This long tedious wait saps their strength and curtails their activities after the rains come, even if they do have enough energy to get out of the ground. In line with this, it is now pretty well recognised that the drought of 1915 settled the beetle question on the Herbert River. There has been no general infestation in that district since that time. Let us hope, then, that we shall reap some benefit from the hardship.

A few of the other districts have been more favoured with regard to rainfall. Mossman, in particular, seems to have fared well, as usual; and, furthermore, only a small crop of beetles has emerged. There were very few grubs in evidence in that district last season, so I did not estimate that they would get many beetles. Babinda, too, is most favourably located as to rainfall, and since this is new land the grubs have not been very destructive there. I have made two visits to this section recently, and found the cane in excellent condition—in fact, a drought year appears to be favourable to the well-being of that district. The Johnstone River, on the other hand, which usually has heavy rainfall, is suffering like ourselves.

ON THE VALUE OF ARSENIC FOR CANE GRUBS.

Mr. H. J. Castor, at Mourilyan, has secured a successful crop from land which he treated with white arsenic at the rate of 15 lb. to 20 lb. per acre. This is especially interesting, since this land has previously failed—the grubs eating the cane right out of the ground. Unfortunately, he kept no check plots, so we are unable to judge just how much of the benefit was due to the poison.

THE BEETLE BORER OF SUGAR CANE.

Investigation of this pest at Mourilyan showed that it is thoroughly established throughout the area. Of course, most of the cane is now cut; but the old channels of the borers are much in evidence in the discarded sticks, and the beetles are easily found in most of the fields.

The farmers there generally recognise the importance of planting clean seed. However, as I pointed out in a former report, there is danger of leaving this seed in the field any time after cutting, for the beetles are attracted to the cut surfaces, where they deposit their eggs. In one instance, a Mourilyan grower left his plants in the field for a few days on account of rain. When planted, the strike was so poor that he investigated, and found that almost every plant was riddled by the borers.

BREEDING OF THE MUSCARDINE FUNGUS.

I have had a large cabinet constructed at the Mulgrave Mill for this work, built on the plan of that illustrated in Trinidad Circular No. 8. This cabinet is about 6 ft. high, with ten shelves of galvanised iron 2 ft. 9 in. square. The food for the growth of the spores is deposited on these shelves and subjected to sterilisation by steam before inoculation with pure culture of the disease organism. Several bushels of the spore-laden material can be developed in this way, and this is scattered in furrows throughout the grub-infested fields. Insects coming in contact with these spores, under moist, cool conditions, become diseased and quickly succumb. Hence the idea is to see if we can multiply the disease so as to form an epidemic among the grubs in fields which are badly infested; and, furthermore, to scatter the disease in other districts where it is not now present.

Under favourable conditions during 1917, I found fully 30 per cent. of the grubs destroyed by this fungus in some fields at Greenhills. It will be interesting to see if we can increase the contagion.

The spores develop on any starchy substance; hence rice was used in this work in Trinidad. Here, however, the present price of rice is prohibitive; and I have cast about for other substances. Cornmeal was used in this sort of breeding work in Illinois, and I found that it does even better than rice, if finely ground and mixed into a thick mass after cooking with steam. The mat of spores on this substance is perfect. I also tried flour paste and sliced sweet potatoes, and, though they do fairly well, they are not nearly as satisfactory as the cornmeal.

Under laboratory conditions here, the fungus begins to show as compact white spots one day after planting, and signs of the green spores are noticeable in the centres on the second day; within a week, the whole substance is a compact mass of the green fruiting.

The Horse.

THE MULE *V.* THE HORSE.

By J. A. RUDD, L.V.S. (Melbourne).

The American draught horse, as I saw him in France, arrived at a time during the war when there was more and better shelter, and he was therefore less exposed to the rigours of the winter; and this fact would, no doubt, have some bearing on his freedom from respiratory affections as compared with Shires and Clydesdales bred in the British Isles. He was not as sound as our Australian horses, ringbones and side bones being very prevalent. The majority were flatfooted, and suffered in consequence from bruised soles and punctures, and seemed to be very prone to ophthalmia in comparison with other breeds of draught horses.

The Australian Clydesdale was, in my opinion, the best type of draught horse for heavy haulage under all conditions.

They stood hardship better than other horses, and, as a majority, had better feet and legs, and, taken all round, were of better conformation and tougher constitution. The Australian thoroughbred was also a very useful animal, and did all that was required of him, and was capable of doing long stages without water. The Suffolk Punch was too small for heavy draught work. The majority, as I saw them, were flat-footed and round boned. In the soft fen country of England there is no doubt that they would make good, and prove a very useful type of horse, but they were hopeless for heavy haulage on hard roads, and they seemed to me to be top-heavy and overbalanced. The same applies to the Percheron in France. Lameness and skin soreness seemed very prevalent among them.

I do not think we can do better than stick to the Clydesdale as the best all-round horse for heavy work in Queensland under all conditions.

We should endeavour to encourage the breeding of the small, thick, low-set type of horse as being more handy than the leggy animal, and easier to nick in an arteross.

The North American mule did much useful service as a transport and pack animal, and helped a good deal. He was handy under certain conditions, but fairly susceptible to epidemic disease. He was very apt to give one a surprise when it was least expected. There are certain advantages in the breeding of mules and also disadvantages.

If the former outweigh the latter, then this Department may rightly give some consideration to the breeding of mules for work in the sugar districts of this State, and encourage mule breeding as an industry by importing a good American jack.

A good American jack donkey should stand 14.2 h.h., be dark-brown in colour, wide in the chest, straight along the back, and not cow-hocked. He should be free from hereditary disease, should stand square on his feet, being neither overshot in front nor sickle-hocked behind, and should move true at the trot with good action, and above all descend from a sire whose ancestral qualification showed tractability and docility. A good jack costs about £300 in America, but it may be possible to procure one in Victoria, bred in that State from pure American parents, at a lesser price or one-third the above cost.

Advantages.

1. A mule, which is a hybrid and a cross between a jack donkey and a mare, seldom inherits defects from an unsound mare, *e.g.*, mares which are unsound will, with very few exceptions, breed sound mules.

2. Mules come into work earlier than horses. At two years of age, a mule could do a fair amount of useful work and will last, with ordinary care, until he is thirty years of age.

3. The mule will live and thrive on sugar-cane tops, and will require less food, and will do better on rougher food than horses.

4. They stand heat better and will do better work on Northern areas.

5. They will haul the same load as easily as a horse twice their weight, at a pinch, and will always, weight for weight, haul more than a horse.

6. They cost less to keep, and they do not require the same care as horses.

7. A jack donkey costs less to keep than any other sire.

8. Mules have strong hoofs with a thick wall and sole, and the horn is of greater density than in the majority of horses. If care is taken of their feet until they are four years of age, they can run on almost any road without being shod, but once they are shod, it is difficult for them to do without shoes.

9. It is easier to purchase a sound jack than a sound stallion.

10. The jack donkey as a sire is always more prepotent than a stallion, and the percentage of fertility is always higher when the jack donkey is used as a sire.

Disadvantages.

1. It is not easy to purchase a good jack donkey.

2. Mules, as a rule, are more subject to epidemic disease than horses.

3. They cannot with safety be allowed to mix with horses on a farm.

4. They are more difficult to handle, and not so tractable as a horse.

5. If a mule makes up his mind to break out of a paddock, there is no fence on a farm that will hold him. The upkeep in fencing is therefore greater, but a mule's remarkable immunity from accident should be taken into account.

6. He does not look as well as a horse and cannot be depended on to the same extent.

7. A mule, being hybrid, cannot be used for stud purposes, therefore his value in this respect is *nil*.

8. An ill-tempered jack donkey will reproduce this bad fault in his progeny.

9. Docility and tractability in a mule depends to a large extent upon and varies with the individual who attends him; and once he is ruined, he can never be reformed. Under any circumstances it takes a mule some weeks before he will take kindly to a change of attendant and surroundings.

10. A mule makes the best pack animal procurable, and will stand the work under heavy loads in hilly country, and under all conditions, better than horses.

General Notes.

SOCIETIES, ETC.

SARINA.—The Plane Creek Canegrowers' Association (Mackay). P. Olsen, Secretary.

MACKAY.—The Homebush Canegrowers' Association. Emil Fox, Secretary.

MACKAY.—The Oakenden Canegrowers' Association. James R. Waters, Secretary.

THE FIRST AEROPLANE FLIGHT FROM ENGLAND TO AUSTRALIA.

The following excellent account of the daring flight of Captain Sir Ross-Smith, accompanied by his brother, Sir Keith Smith, Sergeant J. Bennett, and Sergeant Shiers (all Australians), from England to Port Darwin, as given by the "Producers' Agency," Sydney, is a record which should be read by all Australians, and we place it before our readers for their information and that of the rising generation:—

In 1919 the Commonwealth Government offered a prize of £10,000 to the pilot who first accomplished a flight in an aeroplane or seaplane from Great Britain to Australia within 720 consecutive hours, before midnight of December 31st, 1920. The principal conditions were:—A complete aircraft to be entirely constructed within the confines of the British Empire; the pilot and crew to be of Australian nationality, in accordance with the laws of the Commonwealth; entrance fee £100; only one aircraft to be used throughout the flight; a start to be made from Hounslow aerodrome or Calshot seaplane station; the point at which the competitors finish to be in the neighbourhood of Port Darwin; towing on the water not prohibited, but the total distance of such towing must not exceed 100 miles, of which not more than 50 miles must be consecutive.

Captain Ross-Smith (son of the manager of Mutooroo Station, S.A.) enlisted in August, 1914. He, with his brother Keith and two others—viz., Sergeant Shiers, of South Australia, and Sergeant J. Bennett, of Melbourne—left Hounslow on November 12th, 1919, on a 360 horsepower Vickers Vimy, of the type used in the flight by Captain John Alcock across the Atlantic last June. Northern France was traversed through snow, and he reached Lyons in 400 minutes. He left there on the 13th, and reached Pisa the same day. Rome was made on the 15th, and Taranto on the following day. He left for Crete on the 17th; this was the worst trip experienced. He flew 500 feet above the ground through mist and rain, following the coastline of Greece. On the 18th he left Crete and reached Cairo. He flew to Damascus on the following day, the 19th. On the 20th he left in rain, climbed among the clouds, and headed for Bagdad, but was forced to land at Ramadie. From here to Basra on the Persian Gulf was his first good flying day. Delhi was reached on the 26th. He left there next day, arriving at Calcutta on the 28th. From there he proceeded to Akyab. He arrived at Rangoon on November 30th, followed one hour later by Etienne Poulet, a French aviator, who left Paris on the 15th October, or 29 days before Captain Ross-Smith. Poulet was not a competitor for the Commonwealth prize, but he was endeavouring to reach Australia on his own account; but many people looked upon him as a competitor with Ross-Smith, or as a pacemaker with him. Poulet, in a Cauldron biplane which had seen long service, and was of small design, did remarkably well up to Karachi, where his mechanic, Benoist, contracted fever, and Ross-Smith, making long flights, including one of 660 miles from Suda Bay to Cairo, rapidly gained on the Frenchman in the journey across Southern Asia. Poulet eventually retired from the flight, owing to his machine being put completely out of commission by the breaking of a piston.

From Rangoon, Ross-Smith made fast time *viâ* Singapore, Java, and Timor Island to Darwin, which place he reached at 3.40 p.m. on Wednesday, 10th December, covering the journey within 28 days in the flight from England to Australia, the longest in the history of the world. The actual flying time from the start was 125 hours, or 5 days and nights and 5 hours. The average speed was 85 miles an hour.

The aviators were entertained at dinner at the Victorian Hotel, Darwin. The Administrator said that "practically fifty years ago a cable was brought to Darwin, which first brought Australia into touch by cable with the outside world. That day it had been the landing-place of the Australian aviators, whose skill and daring had forged a new link between Australia and the outer world." In a cable it was stated that "three cheers had been given for Ross-Smith in the House of Commons."

The Markets.

PRICES OF FARM PRODUCE IN THE BRISBANE MARKETS FOR JANUARY, 1920.

Article.		JANUARY. Prices.
Bacon	lb.	1s. 4d.
Barley	bush.	...
Bran	ton	£12 12s. 6d.
Broom Millet	„	£40 to £60
Broom Millet (Sydney)	„	£50 to £70
Butter (First Grade)	cwt.	...
Chaff, Lucerne	„	£15 to £18
Chaff, Mixed	„	...
Chaff, Oaten	„	£14 to £18
Chaff, Wheaten	„	£12 to £15
Cheese	lb.	1s. to 1s. 0½d.
Flour	ton	£15
Hams	lb.	2s. 4d.
Hay, Lucerne	ton	£8 to £12
Hay, Oaten	„	£15
Hay, Wheaten	„	£10
Honey	lb.	7d. to 7½d.
Maize	bush.	8s. 6d. to 10s. 1d.
Oats	„	...
Onions	ton	£15 to £19 10s.
Peanuts	lb.	7d. to 10d.
Pollard	ton	£13 2s. 6d.
Potatoes	„	£20 to £54 15s.
Potatoes (Sweet)	s. bag	9s. to 11s.
Pumpkins (Cattle)	ton	£24 to £25
Pumpkins (Table)	doz.	12s. to 13s.
Pumpkins (Table)	sack	25s. to 30s.
Eggs	doz.	1s. 4½d. to 2s. 2d.
Fowls	per pair	8s. 6d. to 12s.
Ducks, English	„	6s. to 7s.
Ducks, Muscovy	„	9s. to 12s.
Geese	„	11s. to 15s.
Turkeys (Hens)	„	15s. to 18s.
Turkeys (Gobblers)	„	20s. to 50s.
Wheat	bush.	7s. 6d.

VEGETABLES—TURBOT STREET MARKETS.

Beans, per sugar-bag	3s. to 15s.
Beetroot, per dozen bunches	1s. to 2s.
Cabbages, per dozen	3s. to 23s.
Carrots, per dozen bunches	9d. to 1s.
Cucumbers, per dozen	1s. to 3s.
Lettuce, per dozen	6d. to 1s.
Marrows, per dozen	3s. 6d. to 5s.
Peas, per sugar-bag	6s. to 16s.
Potatoes (Sweet), per sugar-bag	7s. to 9s. 6d.
Pumpkins (table), per sack	25s. to 30s.
Tomatoes, per quarter-case	7s. to 16s. 6d.
Turnips, per doz. bunches	3s. to 4s.

SOUTHERN FRUIT MARKETS.

Article.	JANUARY. Prices.
Bananas (Queensland), per double-case...	22s. to 25s.
Bananas (Tweed River), per double-case	20s. to 25s.
Bananas (Fiji)	...
Lemons, per bushel-case	22s. to 25s.
Pineapples (Queens), per double-case	10s. to 18s.
Pineapples (Ripleys), per double-case	12s. to 16s.
Pineapples (Common), per case	7s. 6d. to 10s.
Oranges (Navel), per case...	30s. to 32s.
Oranges (Other), per case	20s. to 21s.

PRICES OF FRUIT—TURBOT STREET MARKETS.

Apples, Eating, per bushel-case	6s. to 18s.
Apples, Cooking, per bushel-case	4s. to 14s.
Apricots, per quarter-case...	12s. 6d. to 15s.
Bananas (Cavendish), per dozen	3d. to 1s. 1d.
Bananas (Sugar), per dozen	5d. to 9d.
Cocoanuts, per sack	15s. to 25s.
Grapes, per lb.	3d. to 5½d.
Lemons (Lisbon), per half bushel-case	15s. to 25s.
Lemons (Rough), per cwt.	...
Limes, per half bushel-case	...
Mangoes, per case	4s. to 11s.
Nectarines, per quarter-case	8s. to 17s. 6d.
Oranges, per case	6s. to 15s.
Papaw Apples, per case	4s. to 16s.
Passion Fruit, per quarter-case	5s. to 9s.
Peaches, per quarter-case	5s. to 10s.
Plums, per quarter-case	9s. to 13s. 6d.
Pineapples (Smooth), per dozen	7s. to 10s.
Pineapples (Rough), per dozen	5s. to 8s. 6d.
Pineapples (Ripley), per case	...
Rock melons, per dozen	...
Strawberries, per dozen pint-boxes	...
Tomatoes (prime), per quarter-case	11s. to 15s.
Tomatoes (inferior), per quarter-case	4s. to 9s.
Water melons, per dozen	6s. to 25s.

TOP PRICES, ENOGGERA YARDS, DECEMBER, 1919.

Animal.	DECEMBER. Prices.
Bullocks	£24 5s. to £27 10s.
Bullocks (single)	£34 10s.
Cows	£15 2s. 6d. to £17 15s.
Merino Wethers	66s.
Crossbred Wethers	67s.
Merino Ewes	38s. 6d.
Crossbred Ewes	60s. 6d.
Lambs	43s. 9d.
Pigs (Backfatters)	£9 10s.
Pigs (Porkers)	87s.

Orchard Notes for March.

THE SOUTHERN COAST DISTRICTS.

The marketing of the main crop of pineapples will continue to occupy the attention of growers; and as it is probable that the plantations have been allowed to get somewhat dirty during the previous month, they should be cleaned up as soon as ever the crop has been got off. The fruit of the new crop of citrus fruit will be showing signs of ripening towards the end of the month; and as the fruit during this period of its growth is very liable to the attack of insect pests of various kinds, it is important that steps should be taken to prevent loss arising from this cause as far as possible.

Large sucking moths of several kinds attack the fruit as soon as it shows signs of ripening; and as they always select the first fruit that shows signs of colouring, it is a good plan to gather a few forward fruit and to ripen them up quickly by placing them on a barn floor, and covering them up with bags or straw. They will turn colour in a few days, and develop the characteristic scent of the ripening fruit. The fruit so treated should be hung up in conspicuous places in the orchard as trap-fruit, as not only will it attract the moths, but also the fruit-flies. The moths will be found clustered round the trap-fruits in large numbers, and can then be easily caught and destroyed. Fruit-fly will also puncture such fruit; and if the fruit is destroyed before the larvæ reach maturity, a later crop of these insects is prevented from hatching out. Fruit-flies may also be caught in large numbers by means of such artificially ripened fruits. The fruits are smeared with tanglefoot, and hung about the orchard. The fly, attracted by the colour, settles on the fruit, and is caught in a similar manner to house-flies on specially prepared sticky paper. These simple remedies, if carefully carried out, will result in the destruction of large numbers of sucking moths and fruit-flies.

The yellow peach-moth that does such damage to peaches in spring, and that attacks corn, sorghum, cotton bolls, custard apples, and many other plants and fruits, often does a lot of damage to citrus fruits. It acts in a very similar manner to the second and later generations of the Codling moth of pomaceous fruits, in that it lays its eggs where two fruits touch, under the shelter of a leaf on the fruit, at the stem end of the fruit, and, in the case of navel oranges, in the navel itself; in fact, anywhere that there is a likelihood of the egg not being disturbed. The egg hatches out into a small spotted caterpillar, which eats its way into the fruit, causing it to ripen prematurely, and fall off. Where two fruits touch, it often eats into and destroys both, and it frequently leaves one fruit to go and destroy a second. It is a very difficult insect to deal with, owing to the number of fruits and plants on which it lives; but, as far as citrus fruits are concerned, the best remedy is undoubtedly to spray the fruit with a remedy that will destroy the young insect when it starts to eat the skin of the fruit. Bordeaux mixture has been found efficacious, but I am of opinion that spraying with Paris green and lime, Kedzie's mixture, or arsenite of lead, will also have good results. The latter poison is, in my opinion, well worth giving a thorough test, as it sticks to the fruit and leaves for a long time. Bordeaux mixture, either alone or in conjunction with Paris green or Kedzie's mixture, is, however, a good remedy, as not only will it destroy the larvæ or prevent the moth from attacking the tree, but it is also the best remedy for black brand or melanose, as well as tending to keep all other fungus pests in check. Fight fruit-fly systematically—both by means of the sticky fruit already recommended and by gathering all fly-infested fruit, such as guavas, late mangoes, kumquats, &c., as well as any oranges or mandarins that may have been infested, as if kept in check now there will be little loss throughout the season. A little fruit will be marketed towards the end of the month. See that it is gathered and sweated for seven days before marketing, and don't gather it too immature. Beauty of Glen Retreat mandarins are often gathered

LAW SOMNER'S
FOR FODDER CROPS

Sheep's Burnet

A most valuable Fodder Plant. It will thrive on the poorest chalk soils, and is very suitable for dry countries where Lucerne or Clover will not succeed. Thrives well on rich or poor land—either on flats or hills. It is one of the best drought-resisting plants we know of, and when once established will repay any farmer. It is greatly liked by cattle if sown with other grasses and clovers, and is now in great demand. Price, 1/6 lb.; 140/- cwt., f.o.b. Melbourne.

Teff Grass

Introduced from South Africa some years ago, where it has proved of immense value for fodder. Cattle, Horses, Pigs, and Sheep devour it greedily. One farmer declares that cattle will leave green lucerne for it. Teff will thrive on any ground, wet or dry. Will grow luxuriantly where lucerne will not live. Teff has been cut for hay within seven weeks from the time it was sown. Prices, 1/6 lb.; 150/- cwt., f.o.b. Melbourne.

Seed Maize

ALL GOLD—This Maize has a stout stalk and plenty of flag. Has yielded fully 120 bushels to the acre. 12/6 bushel, f.o.b. Melbourne.

Turnips and Swedes

Are excellent feed for Cattle, Horses, Sheep, and Pigs. Ready in the late Autumn, and if pulled and stored can be kept for a long time during the winter months, when other feed is scarce. 5/- lb.; 4/6 lb. in 7-lb. lots or more; f.o.b. Melbourne.

Giant Half Sugar Mangel

Undoubtedly the most nutritious of all Mangels for feeding stock. It combines the large size of the Mangel with the greater feeding value of the Sugar Beet, which it outyields by two to one. Roots average about 12 inches in length, and 8 inches in diameter. 4/6 lb., f.o.b. Melbourne.

Sudan Grass

A tall annual grass, which under average conditions reaches a height of 5 feet. It is a great hay producing crop, both in quality and yield. Produces a larger tonnage of hay per acre than any other crop known. Sudan recovers rapidly after cutting, and the next crop is usually ready for harvest within thirty days from the first cutting. It is one of the most drought-resistant plants known, and at the same time it does not blight when moisture is heavy. Sow 5 lbs. per acre in drills, or 15 to 20 lbs. broadcast. 4/6 lb., f.o.b. Melbourne.

Special Fodder Circulars are issued each Season. They are invaluable to farmers. A copy will be sent post free on request.

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